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Service

Southwestern  
Region



# Prescott National Forest

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## Forest Plan Revision EIS

### Fisheries Specialist Report and Viability Analysis

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## Introduction

This Specialist Report is being prepared in support of the Draft Environmental Impact Statement (DEIS) for the Prescott National Forest Proposed Land Management Plan. It evaluates and discloses the potential environmental consequences to fisheries and aquatic species viability that may result with the adoption of a revised land management plan. It analyzes the existing 1987 Prescott National Forest land management plan (USDA Forest Service 1987) and three action alternatives that address the need for change revision topics developed for the plan revision process. Both the National Environmental Policy Act and National Forest Management Act require that effects to species viability be disclosed.

This report documents the effects on fish and aquatic species that are federally listed (under the Endangered Species Act) as endangered and threatened and their designated critical habitat, federal candidate species, Forest Service sensitive species, Management Indicator Species, and other species of concern in the planning area.

## Relevant Laws, Regulations, and Policy that Apply

Below is a summary list of major laws, regulations, and policies that apply to Wildlife, Fish, and Rare Plants management within the USDA Forest Service.

National Environmental Policy Act (NEPA) of 1970, as amended, provides regulations for implementing the procedural provisions of the Act. NEPA requires all federal agencies to give appropriate consideration to environmental factors in the decision making process, to involve affected and interested parties in the analysis process, and to write detailed statements in an Environmental Impact Statement or Environmental Assessment and supporting Specialist Reports that clearly describe the potential impacts of the proposed actions.

The Endangered Species Act of 1973 requires Federal agencies to conserve threatened and endangered species and the ecosystem on which they depend. Section 7(a)(1) outlines the procedures for Federal interagency cooperation designed to conserve federally listed species and their designated critical habitats. Section 7(a)(2) outlines the consultation process the requirement that any action authorized, funded, or carried out by a Federal agency would not likely jeopardize the continued existence of a listed species, or result in the destruction or adverse modification of designated critical habitat.

National Forest Management Act (NFMA) of 1976 requires that habitat be managed to support viable populations of native and desirable non-native vertebrates within the planning area (36 CFR 219.9). USDA regulation 9500-004, adopted in 1983, reinforces the NFMA viability regulation by requiring that habitats on national forests be managed to support viable populations of native and desired non-native plants, fish, and wildlife. For planning purposes, a viable population shall be regarded as one that has the estimated numbers and distribution of reproductive individuals to ensure its continued existence is well distributed in the planning area (36 CFR 219.19). Also, the 1982 planning provisions require that “Forest planning shall provide for diversity of plant and animal communities and tree species consistent with the over-all multiple-use objectives of the planning area” (36 CFR 219.26).

Forest Service Manual 2600 provides directives regarding wildlife, fish, and rare plant management.

## **Current Prescott National Forest Plan**

The current forest plan was approved in 1987 and has been amended seventeen times. The current Plan addresses uses and resources separately without recognition of interrelationships. As a result, management direction is lacking when guidance is needed to deal with more complex situations. For example, appropriate management responses following uncharacteristic fires need to consider the interactions between soils, vegetation structure, coarse woody debris, cultural resources, economics, and work capacity. In some cases, management under the current Plan is appropriate, but the rate of implementation is too low to alter the direction of trends currently moving away from desired conditions. The current plan revision process illuminated many gaps in the existing plan, pointing to potential needs for change in the existing forest plan:

### **Goals/Desired Conditions**

- are either missing or inadequate to guide projects in many of the Forest's PNVTs, which allows for projects to move forward that do not make progress towards desired conditions
- are missing for invasive species presence or influence
- do not integrate desired disturbance processes
- are sometimes written as standards and/or guidelines, rather than desirable conditions to move toward

### **Objectives**

- are focused primarily on outputs, rather than progress toward desired conditions, goals and objectives
- are sometimes expressed as guidelines

### **Standards and/or Guidelines**

- are often unnecessarily prescriptive about how to accomplish a project, instead of focusing on the project outcome
- do not support attaining desired conditions or accomplishing objectives
- are duplicative or conflict with direction already found in Forest Service handbooks and manuals, existing laws and regulations, or recovery plans and strategies for federally listed species
- are based on outdated policy, science, or information
- sometimes describe purely administrative functions, such as budgeting, rather than Plan components and can be confused with Plan direction
- include out of date terminology such as wildland fire use.

### **Monitoring**

- focuses on outputs, rather than on progress toward attainment of goals/desired conditions

### **Plan Direction/Goals for Wildlife and Fish Habitat**

- Manage for a diverse, well distributed pattern of habitats for wildlife populations and fish species in cooperation with states and other agencies.
- Cooperate with the Arizona Game and Fish Department to meet or exceed management goals and objectives in the Arizona Cold Water Fisheries Strategic Plan.
- Maintain and/or improve habitat for threatened or endangered species and work toward the eventual recovery and delisting of species through recovery plan implementation.
- Integrate wildlife habitat management activities into all resource practices through intensive coordination.
- Support the goals and objectives of the Arizona Wildlife and Fisheries Comprehensive Plan, as approved by the Southwestern Regional Forester and Director of the Arizona Game and Fish Department.

### **Plan Revision Need for Change**

The Analysis of the Management Situation (AMS) identified five areas where there are priority needs for change under the existing management plan:

- Restore vegetation arrangements, plant species, and fire to selected ecosystems, while using adaptive management to respond to citizen concerns related to smoke emissions.
- Maintain/improve watershed integrity to provide desired water quality, quantity, and timing of delivery.
- Provide sustainable, diverse recreational experiences that consider population demographic characteristics, reflect desires of local communities, avoid overcrowding and user conflicts, and minimize resource damage.
- Provide desired habitat for native fish.
- Enhance the scenic value of Prescott NF-provided open space by defining the value of the visual character within areas near or viewed by those in local communities.

The AMS determined that native fish and other aquatic species are in decline in some watersheds in the analysis area. Five such watersheds historically supported native aquatic species that are no longer known to be present. The most pressing threat to native species continues to be impacts such as predation from non-native species. Removal of non-native species is under the authority of the State of Arizona (AZ Game and Fish Dept.); the state is responsible for managing species. The Forest Service manages habitat. In order to assist in responding to the decline in native fish species, the Prescott NF can provide habitat and watershed characteristics that will support native fish species. It could also partner with the State of Arizona in addressing control of non-native species. The evaluation of effects on aquatic species viability of the Forest Plan alternatives will use the following indicators in Table 1.

**Table 1. Analysis indicators for comparison of alternatives**

<b>Species consideration between existing condition and alternatives.</b>	<b>Indicator for Alternative Comparison</b>
How would actions listed in each alternative affect aquatic species of viability concern?	Trends in habitat quantity, quality, and distribution Trends in species distribution and abundance
How would actions listed in each alternative affect Management Indicator Species? (The Prescott NF has chosen aquatic macro-invertebrates as an MIS for the revised plan.)	Trends in habitat quantity, quality, and distribution Trends in species distribution and abundance

## **Desired Conditions for Fisheries and Aquatic Species**

Desired conditions are the focus of the Forest Plan and are the basis for developing objectives and other plan components. Two Aquatic DCs were developed for the plan revision (DEIS):

### **DC – Aquatic-1**

- Streams, springs, and wetlands that have potential to support native fish and/or other aquatic species provide quality and quantity of aquatic habitat within the natural range of variability.
- Quantity and timing of water flows are maintained in streams, groundwater dependent ecosystems, and wetlands to retain or enhance aquatic habitat and ecological functions.
- Water quality is sustained at a level that retains the biological, physical, and chemical integrity of the aquatic systems and benefits survival, growth, reproduction, and migration of native aquatic species.
- Riparian vegetative communities within these aquatic habitats are intact and functioning.
- Aquatic habitats are free of or minimally impacted by non-native plant and animal species.

### **DC-Aquatic-2**

- Desired non-native fish species are present only where recreational fishing opportunities are emphasized.

## **Description of Affected Environment**

Information on the historical and existing conditions of the Aquatic Ecosystem and Riparian Forest PNVT (Potential Natural Vegetation Types) in the planning area are taken from the Ecological Sustainability Report (Forest Service 2009), Water Resources Report (Jarnecke and others 2008), Aquatic Species Diversity Report (Sillas 2008) and other references as cited.

## **Reference Conditions**

There is little data for HRV (Historical range of variation) for many hydrologic characteristics, such as mileage of perennial streams or number of seeps and springs, and there is not enough

information to estimate departure from HRV. An alternative method to assess the Aquatic Ecosystem was developed that evaluated characteristics for their representation and redundancy in the 5<sup>th</sup> HUC watershed and 4<sup>th</sup> HUC sub-basin scales to indicate the relative health of each sub-basin (Jarnecke and others 2008). The characteristics that were evaluated included perennial streams, water yield, water quality, riparian/wetland features, seeps/springs/stock tanks, and aquatic species. Historically, perennial stream extent is inferred to have been similar in location and length with similar to slightly more actual flow than today's extent. See Table 8 for a summary of Aquatic Ecosystem conditions on the forest.

## **Aquatic Ecosystem**

The Prescott NF land base falls within portions of eight HUC 4 sub-basins and twenty-two HUC 5 watersheds (Table 2). At the 4<sup>th</sup> HUC scale, the Prescott NF has a relatively minor portion of watershed area, ranging from 13 to 22 percent of watershed area in five of the eight sub-basins. The Prescott NF occupies less than 1 percent of the total area in the Big Sandy sub-basin and less than 5 percent in the Burro Creek and Lower Verde sub-basins. Overall, the Prescott NF contains 13 percent of the total extent of 4<sup>th</sup> HUC sub-basins and contributes 11% of perennial stream miles.

Big Sandy River, Burro Creek, and Santa Maria River all flow to the Bill Williams River Basin, which empties into the mainstem of the Colorado River near Parker. The Big Chino Wash, Upper Verde, and Lower Verde are sequential, moving down drainage and form the Verde River Basin which joins the Salt River near Phoenix, tributary to the Gila River. The Agua Fria and Hassayampa sub-basins drain to the Middle Gila River downstream from its confluence with the Salt River.

The Verde River is the main perennial<sup>1</sup> stream with about 52 miles occurring on the Prescott NF. There are about 38-miles of river within the Granite Creek and Grindstone Wash watersheds that form the upper Verde River. This section of river is potentially eligible for inclusion in the National Wild and Scenic Rivers System (Forest Service 1981). The upper Verde River also has a proposal to build a fish barrier for the management of listed fish species under the Biological Opinion for the Central Arizona Project (US Fish and Wildlife Service 2008). The Cherry Creek and upper segment of the Fossil Creek watersheds flow through the Verde Valley. This major reach of perennial stream (about 40-miles) is mainly in private ownership and is highly altered from water diversions and development. There is only about 5-miles of Prescott NF lands in this section of that provide public access to the river. The lower segment of the Fossil Creek watershed is within the Verde Wild & Scenic River with about 15.5-miles on the forest (Forest Service 2004a). The other 27 miles of streams within the Prescott NF are perennial interrupted<sup>2</sup> or intermittent<sup>3</sup>. These streams are mainly in the Ash/Sycamore Creek and upper Hassayampa River watersheds.

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<sup>1</sup> Perennial – a stream that flows continuously.

<sup>2</sup> Perennial interrupted – a stream with alternating segments of perennial flow and dry stretches.

<sup>3</sup> Intermittent (or seasonal) – a stream that flows only at certain times of the year when it receives water from springs or from surface sources such as melting snow in mountainous areas.

## Riparian Habitat

The extent of the riparian PNVT on the forest is 12,400 acres (<1% of Prescott NF) with an elevational range from 2,000 to 8,000 feet (Forest Service 2009). This vegetation type occurs along perennial or intermittent streams and springs. The two major communities are Cottonwood-willow and Mixed broadleaf deciduous forests. Dominant woody vegetation will vary with elevation, substrate, stream gradient, and depth to groundwater forming a mix of riparian forests, woodlands, and shrublands. Common species include Fremont cottonwood, various willow such as narrowleaf, Gooding, and Bebb; Arizona sycamore, velvet and green ashes, Arizona alder, Arizona walnut, and box elder. Herbaceous plants include several forbs, sedges, rushes, and grasses. Vegetation conditions show a low departure from reference conditions (Forest Service 2009). The departure that currently exists includes the presence of tamarisk and other invasive plants, and a disproportionate amount of mid-development vegetation with tall shrubs and small trees, and a lack of late-development multi-storied forest.

**Table 2. Watershed extent and perennial stream miles**

HUC 4 Sub-basin Name	HUC 5 Watershed (WS)  Name	Area in square miles			Perennial Stream Miles		
		WS	PNF	PNF as % of	WS	PNF	PNF as % of
Big Sandy	Muddy Creek	187	18	9.8	0	0	NA
Burro Creek	Upper Burro Creek	171	13	7.7	19.2	0	0
	Boulder Creek	150	16	10.8	0	0	NA
Santa Maria	Kirkland Creek	405	74	18.3	16.4	0.89	5.4%
	Sycamore Creek	237	152	64.3	2.89	0.16	5.5%
Big Chino	Lower Partridge Creek	204	1	0.4	0	0	NA
	Middle Big Chino Wash	300	38	12.7	0	0	NA
	Williamson Valley Wash	321	169	52.6	11.5	0.08	0.7%
	Lower Big Chino	364	136	37.5	0.45	0.45	100%
Upper Verde	Granite Creek-Upper Verde River	359	70	19.5	13.6	4.09	30.1%
	Hell Canyon	237	104	44.0	4.39	0.54	12.3%
	Sycamore Creek	477	35	7.4	11.4	0.84	7.4%
	Grindstone Wash-Upper Verde River	309	227	73.5	33.6	27.9	83.1%
	Cherry Creek-Upper Verde River	226	117	51.6	32.7	3.39	10.4%
Lower Verde	Fossil Creek-Lower Verde River	299	65	21.7	48.8	18.37	36.0%
Agua Fria	Ash Creek and Sycamore Creek	261	232	89.1	22.5	7.68	34.2%
	Big Bug Creek-Agua Fria River	324	90	27.6	7.57	0.88	11.6%
	Black Canyon Creek	244	158	64.9	0.38	0.38	100%
	Bishop Creek	236	26	11.0	11.66	0.4	0.03
	Agua Fria River-Lake Pleasant	372	25	6.6	1.79	0.39	21.8%

HUC 4 Sub-basin Name	HUC 5 Watershed (WS)  Name	Area in square miles			Perennial Stream Miles		
		WS	PNF	PNF as % of	WS	PNF	PNF as % of
Hassayampa	Upper Hassayampa River	303	192	63.3	15.1	13.35	88.3%
	Middle Hassayampa River	349	3	0.8	13.0	0	0
<b>Total</b>		<b>6337</b>	<b>1962</b>		<b>266.9</b>	<b>79.4</b>	

Source: Jarnecke and others 2008.

## Historic and Current Disturbances/Management Actions impacting Aquatic/Riparian Ecosystems

This section is a summary of information on the historic and current disturbances and FS management actions associated with the watersheds that intersect with the Prescott NF. Many of these disturbances constitute direct or indirect threats to the condition, distribution, quality, quantity, and function of water resources. Changes in the properties or function of soils and vegetative communities through land management activities and other natural or anthropogenic disturbances can result in changes in the hydrologic cycle (routing, timing, and duration of runoff), accelerate or amplify geomorphic processes (hillslope erosion, gullying, stream sedimentation, etc.) in the uplands and drainage system. These changes can lead to degradation in aquatic habitat quantity and quality and affect aquatic species populations.

### Flooding

Periodic flooding is a natural process and disturbance in stream drainages in the planning area and is influenced by geology, geomorphology (i.e. landform), and climate. Most flooding in the Southwest is tied to winter or monsoonal storm events. Floods can impact fish community structure, aquatic habitat, and riparian vegetation. Flooding usually benefits native fish populations by providing important spawning conditions and can increase recruitment by reducing populations of non-native fishes (Minckley and Meffe 1987, Stefferud and Rinne 1995, Rinne and Miller 2006). Flooding is necessary to structure the stream channel with pools and riffles and creates the conditions for regeneration and growth of riparian vegetation. Major floods can remove riparian vegetation, unravel streambanks, and increase sedimentation into the stream. The frequency and intensity of flooding is closely associated with the amount of precipitation received in the drainage area. Higher magnitudes of flood discharge can occur with winter precipitation that falls as warm rains melting snowpacks in mountainous area or when falling on already saturated soils. A historical flood record for the Verde River exists for the past 115 years (Haney and others 2008). Large flood events have occurred in 1891, 1906, 1920, 1938, 1978 (2 floods), 1980, 1993, 1995, and 2004/2005.

### Drought

Periodic droughts have been reported since European settlement. Severe drought in the 1890s resulted in large scale mortality of livestock. An extended drought occurred from about 1942-57.

Recently the Prescott NF has experienced a number of years of drought (roughly since about 1996) with occasional levels of seasonal moisture at or above the long-term mean. Reduced precipitation results in reduced upland vegetative growth, reduced surface organic matter and ineffective vegetative ground cover putting the soil at risk of accelerated erosion and sediment delivery to connected streams during storm events. As vegetation dries out, there is increased risk of wildfire spread and subsequent accelerated erosion and watershed degradation. Perennial stream riparian vegetation is very resilient to drought and has not been shown to be drastically altered during periods of drought. Periodic drought can favor non-native fish populations by providing stable spawning conditions and allowing them to expand in a stream system. This increase in non-native fish usually has a negative effect on native fish populations due to increased predation and competition (Stefferdud and Rinne 1995, Rinne and Miller 2006).

## Wildfire

Wildfire has been a common occurrence on the forest historically and to the present time. Major wildfires that have impacted the forest have been the Mingus Fire in 1956 (15,000 acres), Castle Fire in 1974, and Cave Creek Complex Fire in 2005 (17,000 acres). The majority of acres burned in recent times have been in the chaparral and piñon/juniper vegetation types. (Table 3). Wildfire is common in the ponderosa pine type but has impacted less acres overall. There has also been some wildfire occurrence in the grasslands. All vegetation types in the planning area are showing a departure in fire frequency from reference levels (Forest Service 2009).

**Table 3. Wildfire by year and vegetation type**

Year	Grassland	Chaparral	Ponderosa Pine	Piñon/Juniper	Total by Year
1989	500		700		1,200
1990		834	80		914
1994		8,500	85	2,798	11,383
1995	626				626
1997			383		383
2000			80		80
2001			1,800		1,800
2002		87	1,263		1,350
2003		987	250		1,237
2004				160	160
2005	884	6,940	44	12,558	20,426
2006		6,584	40	243	6,867
2007		989	630		1619
2008		3,974	3,289		7,263
<b>TOTAL</b>	<b>2010</b>	<b>28,895</b>	<b>8,644</b>	<b>15,759</b>	<b>55,308</b>

## Prescribed Fire

Prescribed Fire has been a common management action across the landscape of the forest in the last 3 decades (Table 4). The frequency and acres treated by fire have been mainly in the chaparral and ponderosa pine vegetation types. Grassland burning was common beginning in the early 1980's through the mid 1990s. There has been little fire use in pinyon/juniper and other vegetation types. Fire use is intended to result in low intensity fire in most vegetation types though it usually is higher in chaparral which is characteristic for this type. All prescribed fire activity follows Forest Plan goals and objectives, standard and guidelines, and any mitigation measures to minimize impacts to the natural resources.

## Timber and Fuelwood harvest

Historically, much of the accessible timber and fuelwood areas on the forest were harvested to support the mining industry and growing population centers near the forest. Currently, timber harvest is used primarily as a tool for fuel reduction and ecosystem restoration. From 1986 to 2002, timber sale contracts issued ranged from zero to two per year totaling 11 contracts. During the period from 2003 through March of 2008, 22 timber sale contracts for 39,021 hundred cubic feet (ccf) were sold in response to mortality caused by insect infestation. Expectations are that current levels will stabilize at about 3,600 ccf per year. From 2001 through the second quarter of 2008, the Prescott NF issued 7,428 firewood permits. Each permit allows collection of a maximum of 8 ccf (10 cords) of dead and down wood. This use is trending upward with issuance of 679 permits in 2001 and 1,207 issued in 2008. All timber and fuelwood harvest activity follows Forest Plan goals and objectives, standard and guidelines, and any mitigation measures to minimize impacts to the natural resources.

**Table 4. Prescribed burn treatments by year and vegetation type**

Year	Grassland	Chaparral	Ponderosa Pine	Piñon/Juniper	Total by Year
1987	6,131	6,948			13,079
1988	5,794	11,058			16,852
1989	3,868	2,985	152		7,005
1990		1,150	270		1,420
1991	1,932	1,403			3,335
1992		4,004	1,051		5,055
1993		2,629			2,629
1994		1,914	448	3,916	6,278
1995		5,360			5,360
1996		1,589	443		2,032
1997			1,876		1,876
1998		3,083	902		3,985
1999		6,925	1,080		8,005
2000		2,147			2,147
2001	2,553	51,195	412		54,160
2002		300	210		510

Year	Grassland	Chaparral	Ponderosa Pine	Piñon/Juniper	Total by Year
2003		7,500	550		8,010
2004		6,169	5,127		11,296
2005		3,934	2,048		5,982
2006		7,170	5,765		12,935
2007		2,233	7,001		9,234
2008		10,050	2,856		12,906
<b>TOTAL</b>	<b>20,278</b>	<b>88,551</b>	<b>30,191</b>	<b>3,916</b>	

### **Vegetation treatments**

Mechanical treatments are also used for fuels reduction in chaparral. Brush crushing has been used more recently in this vegetation type to create fire lines near wildland urban interface areas such as Prescott, Dewey, and Cherry. To date, a total of about 4500 acres have been completed with about 1300 acres remaining to complete. Noxious weed treatment of tamarisk along the Verde River has been completed along 18 miles of river since the signing of the Noxious Weed EIS for the forest (Forest Service 2004b). All vegetation treatments follow Forest Plan goals and objectives, standard and guidelines, and any mitigation measures to minimize impacts to the natural resources.

### **Herbivory**

Livestock grazing has occurred throughout the Prescott NF since the late 1800's. Both cattle and sheep have grazed portions of the Forest; however, sheep grazing currently makes up only a very small percent of permitted use. Because of the limited distribution of water and the adjacent lush herbaceous vegetation, cattle commonly concentrate grazing along perennial and intermittent streams, in riparian areas and wetlands around seeps and springs. Unmanaged herbivory has been observed to reduce effective vegetative ground cover and riparian vegetation and contribute to accelerated erosion, soil compaction and sedimentation to connected perennial waters and reduce or impair water quality. Currently, livestock grazing occurs on the majority of the forest within 62 allotments. Two-thirds of the allotments have yearlong grazing with the other third being seasonal (typically 6-month) grazing. Management actions in 1997 restricted livestock grazing along the upper Verde River on the forest because of presence of federally listed fish species. The Verde Wild & Scenic Management Plan (Forest Service 2004a) fenced off livestock grazing from along the river. All livestock grazing activity follows Forest Plan goals and objectives, standard and guidelines, and any mitigation measures to minimize impacts to the natural resources.

### **Recreation Development and Activities**

The mild climate of the Prescott NF encourages year round recreational activity. Trail and day use are primary types of activity including off highway vehicle riding, hiking and biking. There are 18 developed sites on the Prescott NF; those with highest use include Thumb Butte, Lynx Lake Recreation Area, and Granite Basin Recreation Area. The area surrounding the city of Prescott—the Prescott Basin—has the highest concentration of recreational activity on the Prescott NF and limits primitive camping to designated sites. Two OHV areas are designated on the forest at Alto Pit near Prescott and Hayfield Draw near Camp Verde. The Verde River is a

focal point of water based recreation such as fishing, swimming, and boating. There are several river access points along the river with the majority being in the Verde Valley. A 40-mile stretch of the Verde River below Camp Verde is designated a Wild and Scenic River with about 15-miles occurring on the Prescott NF. Eight designated wilderness areas comprise more than 116,000 acres entirely or partially within the Prescott NF. Demand for outdoor recreation is expected to grow indefinitely as long as populations are increasing. Non-consumptive wildlife and developed recreation will grow the most, exceeding the Forests' ability to supply. Capacity of general forest areas and designated wilderness is expected to experience slower demand growth during the next planning cycle. All recreational development and activities follows Forest Plan goals and objectives, standard and guidelines, and any mitigation measures to minimize impacts to the natural resources.

### **Roads and Trails maintenance and construction**

Roads and trails occur across the landscape on the forest. There are about 1500 miles of forest system roads with the majority being in the high clearance vehicle use category. There are about 400 miles of both non-motorized and motorized forest system trails on the forest. In addition, there are unquantified miles of non-system roads and trails on the forest. Roads and trails have compacted surfaces and low infiltration rates and can generate/ concentrate large amounts of surface runoff. The presence of roads and trails near aquatic habitats can be a source of sediment and pollutants. In addition, roads and trails can impact aquatic habitats through the facilitation of the spread of non-native species, increases in recreational access, and the likelihood of land development. These impacts can result in sedimentation and reduced water quality and affect aquatic habitat quantity and quality. Overall, Forest roads and trails are in poor condition from inadequate maintenance and reconstruction.

### **Mining**

Mining activities began in the 1860's and created the first European settlement within much of the Prescott NF. This was especially the case in the Agua Fria and Hassayampa drainages. Starting with placer mining in streams, many stream channels were altered with sluicing and hydraulic mining – using high powered streams of water to break down alluvial banks and direct them into various sluices and rocker boxes in order to sort out the small volume of valuable minerals, with gold being the first attractant. Subsequently mining with shafts, adits, and small mills became more common, with associated piles of waste rock and tailings. The Prescott NF has abundant deposits of metallic minerals; existing activity includes five mineral material contracts for removal of flagstone, one contract for schist removal, and one contract for removal of decomposed granite. One limestone operation exists with approved commercial plan of operations. Gold mining is limited to placer and/or lode mining. Placer operations would involve mining from alluvial deposits such as panning. Lode operations, also known as hard rock mining, consist of mining a vein bearing gold or a rock in-place valuable mineral deposit. Most placer mining is recreational use or small commercial operators; the Gold Basin Project has the only approved plan of operations. All mining activities follow Forest Plan goals and objectives, standard and guidelines, and any mitigation measures to minimize impacts to the natural resources.

## Dams and impoundments

There are three main dams and impoundments on the forest: Lynx Lake, Granite Basin Lake, and Horsethief Lake. Additional lakes adjacent the forest include Watson, Willow, Goldwater (all owned by city of Prescott), and Hassayampa (private owned) in the Prescott area. All lakes were constructed for recreational use and have established sport fisheries. There are no major dams on the Verde River on the Prescott NF. Sullivan Dam, located before the beginning of perennial streamflow on the Verde River, traps the majority of the bedload sediment from the Big Chino and the Williamson Valley 5th HUCs and has altered the natural sediment load into the upper Verde River and stream channel morphology. The Pecks Lake diversion dam near the city of Clarkdale is a major impediment to fish migration on the Verde River. The diversion dam is currently breached but still forms a partial barrier to upstream fish movement. The majority of other dams and impoundments on the forest are earthen stock tanks constructed to provide water for permitted livestock. Dams and impoundments block the normal flow of streams and capture some of the streamflow, usually from periods of high flow or flood periods. Dams also trap sediment which would otherwise move down through the channel system. Soil erosion is the result of natural geologic processes and its entrapment may affect the ability of downstream channels to replenish alluvial banks and terraces. Other sediment may be the result of human disturbances such as from roads or mining operations

## Water Withdrawals

Withdrawals from both surface water streams and connected groundwater aquifers may affect streamflow on the forest, with main concerns being to the flows of the Verde River. Groundwater withdrawals from Verde River sub-basin are given in Table 5. Perennial flow in the upper Verde River is primarily from the Big Chino Valley aquifers with groundwater discharge via springs supplying at least 80 percent of the upper Verde River baseflow (Wirt and Hjalmarson 2000). This inflow makes up the baseflow of the upper Verde River from river mile 0.2 to mile 22 (Blasch and others 2006). The largest groundwater withdrawals in the Big Chino Sub-basin are for agriculture (7900 acre-feet/year). The majority of the irrigated lands exist in four general locations in the Big Chino Sub-basin. These are near the community of Paulden, along Big Chino Wash about 15-miles northwest of Paulden, along Williamson Valley Wash, and along Walnut Creek (Yavapai County Water Advisory Committee 2004). Although agricultural withdrawals are decreasing from historical highs, groundwater withdrawals for domestic use within the sub-basin are increasing. In the middle Verde Valley (Clarkdale to Camp Verde) diversions for irrigation use have been present since the 1870's and sometimes reduce portions of the Verde River to a trickle during irrigation season. Increasing urban and "ranchette" development with wells is also impacting the streamflow. Irrigated lands in the Verde Valley sub-basin (Verde River Valley, Oak Creek, Wet Beaver Creek, and West Clear Creek sub-watersheds) rely almost exclusively on surface water for irrigation. Over 30 irrigation diversions exist in the Verde Valley that diverts an estimated 15,000 acre-feet of surface water annually (ADWR 2000).

**Table 5. Annual groundwater withdrawals (acre-feet/year)**

Year	Big Chino Sub-basin	Upper Verde Sub-basin
1990	12,341 AF	8,827 AF
1991	12,335 AF	9,837 AF
1992	12,360 AF	9,754 AF

Year	Big Chino Sub-basin	Upper Verde Sub-basin
1993	10,396 AF	10,460 AF
1994	10,444 AF	10,937 AF
1995	10,479 AF	11,438 AF
1996	10,558 AF	12,369 AF
1997	10,597 AF	13,150 AF
1998	11,464 AF	13,181 AF
1999	11,582 AF	13,700 AF
2000	11,848 AF	14,079 AF
2001	12,043 AF	14,501 AF
2002	14,719 AF	16,086 AF
2003	14,526 AF	16,283 AF

Source: (Blasch and others 2006).

### Population Trends

The Prescott NF is located predominately in Yavapai County. The population of Yavapai County grew from 68,145 in 1980 to 167,517 in 2000, an increase of 146% (U.S. Census Bureau 2000). The projected population of Yavapai County in the year 2040 is estimated to be more than 305,000 (ADWR, Statewide Water Planning 1997 *in* Arizona Department of Water Resources 2000). The forest is situated near the communities of Chino Valley, Paulden, Prescott, and Prescott Valley in the west half and Camp Verde, Cottonwood/Verde Villages, and Clarkdale in the east half. Population centers and trends in the area are shown in Table 6. Continued population growth in the watersheds within the planning area would result in greater area of watershed altered by housing developments thus affecting natural hydrology and sediment production, increased use of groundwater resources, and higher recreational use on the forest.

**Table 6. Population trends of selected communities near the Prescott NF**

Community	1990 Census	2000 Census	2009 Estimated
Chino Valley	4,837	7,835	11,182
Paulden	Not available	3,420	3,912
Prescott	26,455	33,938	42,749
Prescott Valley	8,858	23,535	38,463
Clarkdale	2,144	3,422	4,252
Cottonwood	5,918	9,179	11,362
Verde Villages	7,037	10,610	12,830
Camp Verde	6,243	9,451	10,871

Source: U.S. Census Bureau website: [www.census.gov](http://www.census.gov)

### Non-native aquatic species stocking

Introductions of non-native fish and other aquatic species began in the state in the late 1880s. Programmed introductions by federal and state agencies were generally for sportfishing, bait (forage for sportfish), and for biological control for mosquitoes. Other introductions have been made unintentionally by the public into many waters in the state. Stocking within state waters on

the forest occur at Lynx Lake, Granite Basin Lake, Mingus Lake, Horsethief Lake, and winter stocking of rainbow in the Verde River. Non-native fish populations are well distributed and established in watersheds on the forest (Table 7).

## **Fisheries/aquatic species recovery actions and conservation**

Various management actions have been conducted by the Prescott NF for the benefit of native fish and other aquatic species:

- Acquisitions of various parcels of private lands along the Verde River.
- acquisition of in stream flow rights (by Coconino, Prescott, and Tonto NFs) for the Verde Wild & Scenic River from Beasley Flat (T13N, R6E, Sec. 34) to Red Creek (T9.5N, R6E, Sec. 34) for the protection of threatened and endangered fish values.
- filing for in stream flow rights (by Prescott NF) for upper Verde River from NF FS boundary (T17N, R1W, Sec. 5) to FS boundary (T17N, R3E, Sec. 33) and other small streams on the forest for protection of threatened, endangered, and sensitive fish/aquatic species.
- Restriction of livestock grazing from the riparian corridor of the upper Verde River (1997) and Verde Wild & Scenic River (2005) for the protection of threatened and endangered fish species.
- Closure of several roads into the upper Verde River in 1997 to reduce or eliminate vehicle impacts to riparian and aquatic habitat.
- Monitoring of fish populations and aquatic habitat in the upper Verde River in cooperation with the Rocky Mountain Research Station, Flagstaff, Arizona.
- Herbicide treatment of tamarisk and other noxious plants along the Verde River to restore or improve riparian habitat to native vegetation.

## **Summary of Watershed/Aquatic Ecosystem Condition**

Table 8 summarizes the watershed conditions, hydrologic features, and native aquatic species integrity within the HUC 4 sub-basins and HUC 5 watersheds associated with the Prescott NF. Key sub-basin for aquatic ecosystem diversity are the Agua Fria River, Hassayampa River, Verde River Upper, and Verde River Lower because of the amount of perennial stream miles on forest and the native aquatic species known in these streams.

Watershed condition integrity (or wholeness) is a function of natural geomorphology (landform), and the soil and vegetation conditions found in the uplands. Upland conditions affect the water quality, quantity, and timing of delivery downstream that are important to the sustainability of riparian and aquatic habitats. The uplands within the Big Chino Wash, Big Sandy River, Burro Creek, and Upper Verde River sub-basins have reduced watershed condition integrity due to departed soil conditions.

Several sub-basins (*Agua Fria River*, and *Upper* and *Lower Verde River*) exhibit moderate to high levels of redundancy and proportional to over-represented amounts of hydrologic features (riparian areas, seeps/springs, and perennial streams) occurring on the Prescott NF lands within

the sub-basins. The abundance and distribution of these hydrologic features increases the probability that these sub-basins will continue to function in a way that contributes to ecosystem resiliency and diversity over time.

Water quantity is at risk within the Agua Fria River, Big Chino Wash, Hassayampa River, and Upper and Lower Verde River sub-basins due to groundwater pumping and/or surface water diversion for agricultural, domestic, and municipal uses.

Water quality impairment occurs within the Agua Fria River, Hassayampa River, and Upper and Lower Verde River sub-basins that currently do not meet state and national water quality standards. Trends in water quality are considered to be upward or improving.

The majority of sub-basins show a possible loss of aquatic species diversity due to a departure in the number of native aquatic species historically present versus currently present and also due to invasive species now present.

Soils found within Riparian PNVTs are highly variable but generally have a low to moderate biomass production potential. Current soil conditions are moderately departed due to soil loss and inadequate surface OM. Vegetation conditions show a low departure from reference conditions. The departure that currently exists includes the presence of tamarisk and other invasive plants, and a disproportionate amount of mid-development vegetation with tall shrubs and small trees, and a lack of late-development multi-storied forest. On-Prescott NF vegetation conditions are less departed than off-Prescott NF (25% versus 32%).

### **Projected Trends for Watershed and Riparian Features**

There is limited information on projected trends for watershed features. The following projections are based on available literature.

#### **Perennial Streams**

There has been documented regression of perennial streamflow downstream from Del Rio Springs, in a number of tributary segments in the Upper Verde River above Sullivan Dam, and in the Verde Valley (Blasch and others 2006). Proposed and projected increases in groundwater pumping from the Big Chino aquifer have become controversial in terms of their potential impact on baseflows in the Verde River within the Middle Verde 4th HUC sub-basin.

#### **Water Yield**

Water withdrawals through surface water diversions and groundwater pumping are well beyond the historical range of variation. The natural disturbances of droughts and floods are within the historical range of variation. Because total water yield is directly related to precipitation, the current drought (and projections of its potential continuance for a number of years) may result in a continuation of the recent trend of reduced streamflow and somewhat reduced base flows. Predictions from global climate models suggest warmer temperatures and slightly reduced total precipitation, with a high incidence of both droughts and floods. Current trends of a reduced proportion of winter precipitation being snowfall, with earlier spring melt, are predicted to

continue and possibly increase in effect. These factors may result in reduced groundwater recharge and changes in the magnitude, frequency, and duration of streamflows.

Ground water levels have declined due to both withdrawals and recent drought conditions, primarily on the private lands outside the Prescott NF boundary. Potential ground water withdrawals from the Big Chino aquifer authorized by the Arizona Ground Water Transportation Act, along with potential new consumptive uses in the area, could potentially and substantially affect streamflows in the Verde River and headwater tributaries. The Big Chino aquifer has been reported as providing more than 80 percent of the flow for the Verde River headwater springs (Wirt and others 2005). Monitoring and mitigation to reduce effects have been promised by the municipalities proposing to import water from this aquifer. Distinguishing the timing and amount of effects between this pumping and that attributed to other new uses on the aquifer will be difficult.

### **Water Quality**

Water quality that has been degraded by historic mining operations (Hassayampa and Aqua Fria watersheds) is being addressed by a number of remediation projects leading to a trend toward reference condition in those waters. Water quality within the Verde River is degraded by high turbidity and is being improved by several watershed improvement projects to trend toward reference condition.

### **Aquatic Invasive Species**

Non-native fish and other aquatic species continue to dominate the fish community in the Verde River and its major tributaries. Invasive species presence in other small streams on the forest is expected to persist where already established.

### **Riparian PNV**

There were no data to estimate trends for soil and graminoid conditions. No VDDT model currently exists to project over-story vegetation trends for this PNV. Because the amount of riparian vegetation invaded by tamarisk and other invasive plants is not known with certainty, it is possible that the actual departure of Prescott NF Riparian Forests is higher, and more similar to estimates for riparian areas off-Prescott NF. Additional information on riparian vegetation occurrence and condition would clarify these estimates of risk to riparian ecosystem sustainability.

**Table 7. Non-native fish & aquatic species occurrence on the Prescott NF**

<b>HUC 5 Watershed Name</b>	<b>Western mosquitofish</b>	<b>Fathead minnow</b>	<b>Red shiner</b>	<b>Bluegill</b>	<b>Green sunfish</b>	<b>Smallmouth bass</b>	<b>Largemouth bass</b>	<b>Channel catfish</b>	<b>Flathead catfish</b>	<b>Yellow bullhead</b>	<b>Common carp</b>	<b>Rainbow trout</b>	<b>Brown trout</b>	<b>Bullfrog</b>	<b>Crayfish</b>
Muddy Creek															
Upper Burro Creek		X	X		X					X	X				
Boulder Creek		X	X		X					X	X				
Kirkland Creek					X					X					
Sycamore Creek					X					X					
Lower Partridge Creek															
Middle Big Chino Wash															
Williamson Valley Wash	X	X													
Lower Big Chino Wash															
Granite Creek-Upper Verde River	X	X	X		X	X		X	X	X	X			X	X
Hell Canyon					X			X							
Sycamore Creek (Verde River)					X	X				X				X	X
Grindstone Wash-Upper Verde	X	X	X		X	X		X	X	X	X			X	X
Cherry Creek-Upper Verde River	X	X	X	X	X	X	X	X	X	X	X	X		X	X
Fossil Creek-Lower Verde River	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Ash Creek and Sycamore Creek	X	X			X							X		X	X
Big Bug Creek-Agua Fria River															X
Black Canyon Creek		X			X										X
Bishop Creek		X			X										
Agua Fria River-Lake Pleasant														X	X
Upper Hassayampa River					X										X
Middle Hassayampa River	X														

Source: Arizona Statewide Freshwater Assessment ([www.azconservation.org](http://www.azconservation.org))

**Table 8. Watershed and aquatic ecosystem conditions on the Prescott NF**

Sub-basins (HUC 4) Watersheds (HUC 5)	Uplands	Riparian/ Wetland Areas			Springs/Seeps			Perennial Streams			Water Yield		Water Qual.	Aquatic Species
	Watershed Condition Integrity <sup>1</sup> Reduced?	% Sub Basin <sup>2</sup> & ac on PNF	PNF Rep. in sub-basin <sup>3</sup>	Redundancy on PNF <sup>4</sup>	No. in PNF by WS & % of Sub Basin <sup>5</sup>	PNF Rep. in Sub basin	Redundancy on PNF	Miles on PNF by WS & % Sub Basin <sup>6</sup>	PNF Rep. in sub-basin	Redundancy on PNF	PNF% of WS & Sub Basin precip <sup>7</sup>	Water Yield Potential <sup>8</sup>	Miles Cat. 4 or 5 on PNF <sup>9</sup>	No. species no longer present/ No. Non-native spp. <sup>10</sup>
	Soils   Veg													
<b>Agua Fria River</b>		<b>18%</b>	<b>Prop.</b>	<b>Mod</b>	<b>44%</b>	<b>Over</b>	<b>High</b>	<b>16%</b>	<b>Prop</b>	<b>Mod</b>	<b>26%</b>		<b>19.7</b>	
Agua Fria R/L. Pleasant Ash Ck / Sycamore Ck	No   No	46			18			0.39			9.6	High	*	0/2
Big Bug Ck/Agua Fria R.	Yes   No	930			82			7.68			90.0	Mod		2/6
Bishop Ck	No   No	7			39			0.88			32.1	High		0/0
Black Canyon Ck	Yes   No	93			7			0.38			12.4	Mod	*	0/2
	No   No	349			54			0.38			72.0	High	19.7	0/2
<b>Big Chino Wash</b>		<b>54%</b>	<b>Over</b>	<b>Low</b>	<b>83%</b>	<b>Over</b>	<b>Low</b>	<b>5%</b>	<b>Under</b>	<b>Low</b>	<b>18%</b>		<b>--</b>	
Lower Big Chino Wash	Yes   No	223			17			0.45			42.1	Low		0/0
Lower Partridge Ck	Yes   No	0			0			0			0.5	Mod	*	0/0
Middle Big Chino Wash	Yes   Yes	0			0			0			15.2	Mod	*	0/0
Williamson Valley Wash	Yes   No	295			46			0.08			57.6	Low	*	0/2
<b>Big Sandy River</b>		<b>0%</b>	<b>N/A</b>	<b>N/A</b>	<b>0%</b>	<b>N/A</b>	<b>N/A</b>	<b>0%</b>	<b>N/A</b>	<b>N/A</b>	<b>1%</b>		<b>--</b>	
Muddy Ck	Yes   Yes	0			0			0			10.0	Low	*	0/0
<b>Burro Creek</b>		<b>0%</b>	<b>N/A</b>	<b>Low</b>	<b>6%</b>	<b>Over</b>	<b>Low</b>	<b>0%</b>	<b>None</b>	<b>N/A</b>	<b>5%</b>		<b>--</b>	
Boulder Ck	Yes   Yes	6			3			0			12.3	Mod	*	0/5
Upper Burro Ck	Yes   Yes	0			0			0			8.7	Mod	*	0/5
<b>Hassayampa River</b>		<b>11%</b>	<b>Prop.</b>	<b>Low</b>	<b>59%</b>	<b>Over</b>	<b>High</b>	<b>42%</b>	<b>Over</b>	<b>Low</b>	<b>21%</b>		<b>9.3</b>	
Middle Hassayampa R.	No   No	0			2			0			1.0	Mod	*	0/1
Upper Hassayampa R.	No   No	269			102			13.35			65.7	High	9.3	0/1
<b>Santa Maria River</b>		<b>7%</b>	<b>Under</b>	<b>Mod</b>	<b>40%</b>	<b>Over</b>	<b>High</b>	<b>3%</b>	<b>Under</b>	<b>Mod</b>	<b>19%</b>		<b>--</b>	
Kirkland Ck	No   No	28			25			0.89			19.4	Mod		0/2
Sycamore Ck	Yes   No	245			52			0.16			65.7	Mod	*	0/2
<b>Verde River Upper</b>		<b>22%</b>	<b>Prop.</b>	<b>Mod</b>	<b>33%</b>	<b>Over</b>	<b>Mod</b>	<b>20%</b>	<b>Prop</b>	<b>Mod</b>	<b>19%</b>		<b>18.4</b>	
Cherry Ck/Upper Verde	Yes   No	966			60			3.39			55.1	Mod	3.2	4/14
Granite Ck/Upper Verde	Yes   Yes	91			21			4.09			22.7	Mod	--	0/11
Grindstone Wash/UV	Yes   No	685			2			27.91			68.5	Low	15.2	2/11
Hell Canyon	Yes   No	84			2			0.54			38.3	Low	*	0/2
Sycamore Creek	Yes   No	245			6			0.84			6.6	High	*	0/5
<b>Verde River Lower</b>		<b>11%</b>	<b>Over</b>	<b>N/A</b>	<b>6%</b>	<b>Over</b>	<b>N/A</b>	<b>6%</b>	<b>Over</b>	<b>N/A</b>	<b>3%</b>		<b>15.5</b>	
Fossil Ck/Lower Verde	No   No	1,540			25			18.37			19.5	Mod	15.5	1/15

Table 6 footnotes:

<sup>1</sup> A reduction in watershed condition integrity is a level of impairment to biological and/or physical characteristics or processes as summarized in column 2 of Table 15 in the *Water Resources Report* (Jarnecke and others 2008). See also FSH 2521.05 and 2521.01 for explanations of watershed condition integrity.

<sup>2</sup> Data source for riparian acres, representativeness, and redundancy is Southwest Regional Gap Analysis Project (USGS 2004). The proportion of Prescott NF riparian acres within the sub-basin is shown on same row as the sub-basin name (shaded row).

<sup>3</sup> The Representativeness of Prescott NF riparian acreage was compared to the sub-basin as a whole. Calculation: Acres of riparian/wetland vegetation types on Prescott NF in 4<sup>th</sup> HUC divided by total acres of riparian/wetland vegetation types in 4<sup>th</sup> HUC. Underrepresented = <0.8, Proportional = 0.8 to 1.2, Overrepresented = >1.2

<sup>4</sup> The Redundancy of Prescott NF riparian acreage was calculated as presence/absence within each sub-basin and the distribution across WS within the sub-basin. Ratings: High = hydrologic feature found in each WS and relatively well distributed among them. Mod = Riparian feature found in each WS but not well distributed. Low = Occurrences of riparian feature were not found in all WS within the sub-basin.

<sup>5</sup> Number of seeps and springs on Prescott NF are provided for each watershed. The proportion of Prescott NF seeps and springs within the sub-basin is shown on shaded row.

<sup>6</sup> Miles of Prescott NF perennial streams are provided for each WS. The proportion of Prescott NF perennial stream miles within the sub-basin is shown on shaded row.

<sup>7</sup> The Prescott NF proportions of average annual precipitation are taken from tables 3 and 4 (Jarnecke and others 2008).

<sup>8</sup> Water Yield = the total net amount of water produced on the Prescott NF, including streamflow and groundwater recharge.

<sup>9</sup> Miles of streams classified as Categories 4 or 5 by the ADEQ. Category 4 = Impaired or threatened for at least one use but a TMDL (Total Maximum Daily Load) analysis is not required. Category 5 = Impaired or threatened for one or more designated uses by a pollutant and a TMDL needs to be developed or revised. \* = No Prescott NF streams assessed.

<sup>10</sup> Number of aquatic species that historically were present but are not currently found in watersheds on the Prescott NF and the number of non-native aquatic species found within the watershed. Example: 5/15 = 5 species are no longer found/15 non-native spp present. 0/ND=no species extirpated/No data on non-natives.

## Conservation Approaches to Maintaining Species Viability

The primary threats to aquatic ecosystem and species sustainability on the forest include ground and surface water withdrawals and diversions (occurring off-Prescott NF); departed upland watershed conditions (soils, vegetation, and fire regime); degraded water quality including heavy metals contamination; and non-native species competition and predation. The projected trend for groundwater withdrawals is for increased use due to increasing human population growth in the area and has potential impacts to baseflows to the Verde River and other key streams. The maintenance of natural flow regimes is essential for the conservation of native aquatic communities. However, the active management of non-native species is also needed. A conservation strategy to maintain native aquatic species viability on the forest should focus on these two factors as well as maintaining or improving watershed, riparian, and aquatic conditions through our management actions. Below is a list of some conservation actions to be considered.

- Acquire/maintain streamflow water rights for the upper Verde River, Verde Wild & Scenic River section, and other key streams on the forest where groundwater or water diversion are a concern to maintaining existing streamflows. Applications have been made for Sycamore, Cienega, Turkey, Walnut, and several other creeks on the forest.
- Acquire private land parcels with water rights along the Verde River and other key streams on the forest. Also consider private land parcels at Brown Springs and Nelson Place Springs.
- Construct a fish barrier on the upper Verde River and renovate stream section with piscicides to eliminate non-native fish species. Restock with native species. Projects would require collaboration with private, state, and other federal agencies.
- Expand native aquatic species populations on the forest where suitable habitat exist. Potential habitats on the forest include, but are not limited to, Sycamore Creek, Little Sycamore Creek, Little Ash Creek, and Big Bug Creek. These creek sections currently have non-native aquatic species that are limiting native fish populations. Chemical treatment with piscicide and/or mechanical removal to eliminate non-native aquatic species would be necessary. Projects would require collaboration with private, state, and other federal agencies.
- Restore riparian habitats along the Verde River and other key streams where noxious and invasive plant species are present in the riparian zone.
- Restore natural fire regimes in watersheds on the forest to reduce the risk of catastrophic fire and resulting levels of high sedimentation to aquatic habitats. Consideration should be given to the amount of HUC 5 and/or HUC 6 watershed acres treated to minimize effect of sedimentation to species habitat.
- Obliterate and rehabilitate unauthorized/non-system roads in the watersheds to improve water quality in the Verde River and other key streams on the forest.
- Mitigate impacts from mining activities in the Hassayampa, Big Bug Creek, and Turkey Creek drainages.

## Identification of Species

The identification of species for which there is a viability concern was completed as part of the Analysis of the Management Situation (Sillas 2008). That document followed national guidance for selecting and deciding what species would be carried forward for analysis. The nineteen aquatic species being analyzed in this document include twelve fish species, two amphibians, two reptiles, and three invertebrates that occupy or have suitable habitat on the Prescott National Forest (Table 9).

**Table 9. Species considered for Viability Analysis**

Common Name	Scientific Name	Federal Status	Critical Habitat
Gila chub	<i>Gila intermedia</i>	Endangered <sup>4</sup>	Yes
Gila topminnow	<i>Peociliopsis occidentalis</i>	Endangered	No
Razorback Sucker	<i>Xyrauchen texanus</i>	Endangered	Yes
Loach Minnow	<i>Rhinichthys osculus</i>	Endangered	Yes
Spikedace	<i>Meda fulgida</i>	Endangered	Yes
Gila trout	<i>Oncorhynchus gilae</i>	Threatened <sup>5</sup>	No
Colorado Pikeminnow	<i>Ptychocheilus lucius</i>	Experimental <sup>6</sup> Non-essential	No
Roundtail chub	<i>Gila robusta</i>	Candidate <sup>7</sup>	N/A
Desert sucker	<i>Catostomus clarki</i>	Sensitive <sup>8</sup>	N/A
Longfin dace	<i>Agosia chrysogaster</i>	Sensitive	N/A
Sonora sucker	<i>Catostomus insignis</i>	Sensitive	N/A
Speckled dace	<i>Rhinichthys osculus</i>	None	N/A
Mexican gartersnake	<i>Thamnophis eques</i>	Candidate	N/A
Narrow headed gartersnake	<i>Thamnophis rufipunctatus</i>	Sensitive	N/A

<sup>4</sup> Listed Endangered under the ESA: Any species that is in danger of extinction throughout all or a significant portion of its range.

<sup>5</sup> Listed Threatened under the ESA: Any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

<sup>6</sup> Listed Experimental population, non-essential under the ESA.

<sup>7</sup> Listed Candidate, Ready for Proposal for listing under the ESA.

<sup>8</sup> Those species listed on the Regional Forester's Sensitive Species list for the Southwestern Region of the Forest Service.

Common Name	Scientific Name	Federal Status	Critical Habitat
Arizona toad	<i>Bufo microscaphus</i>	Sensitive	N/A
Lowland leopard frog	<i>Rana yavapaiensis</i>	Sensitive	N/A
Brown springsnail	<i>Pyrgulopsis sola</i>	Sensitive	N/A
Verde Rim springsnail	<i>Pyrgulopsis glandulosa</i>	Sensitive	N/A
Maricopa tiger beetle	<i>Cicindela oregona maricopa</i>	None	N/A

The native fishes in the planning area are part of the Lower Colorado River Basin fauna. A total of 31 freshwater fish species are known for this basin (Olden and Poff 2005). Fifteen native fish species have been recorded to occur within the HUC 4 sub-basins, either historically or currently. A total of ten native fish species currently occur within the Prescott NF. The occurrence of fish and aquatic herpafauna species within the 5th HUC is shown in Table 10. The Verde River has the highest native fish species diversity in the planning area and has been identified as one of several stream systems having the greatest potential for native fish restoration and conservation in Arizona (Turner and List 2006). However, original populations of the Colorado pikeminnow, razorback sucker, Gila topminnow, Gila trout, and loach minnow were extirpated from the drainage. The Colorado pikeminnow and razorback sucker are currently being reintroduced into the lower Verde River but with limited success (Hyatt 2004). Gila trout were recently introduced into Grapevine Creek (Big Bug Creek –Aqua Fria River HUC 5) on the forest in 2009. The Gila topminnow, loach minnow, and spikedace were recently introduced into Fossil Creek (Lower Verde River HUC 5) in restoration efforts.

Native fish populations within the Lower Colorado River Basin have experienced declines in their distribution because of loss or modification of habitat and from competition and predation by introduced non-native fishes (Olden and Poff 2005). The majority of fish species known on the forest have undergone declines in distribution across the basin. In contrast, the majority of non-native fish that have been introduced into the basin have shown substantial increases in their distribution over time. Most non-native fish species have well established populations on the forest and are considered a primary threat to native fish species on the forest.

Aquatic reptiles and amphibians have suffered the same fate as native fish in the reduction of distribution and abundance throughout their range. The loss or modification of habitat from various actions and the introduction of non-native fishes, bullfrogs, and crayfish continue to impact populations.

The aquatic invertebrates have limited distribution in the planning area. The Verde Rim springsnail is only known from one spring complex in the headwaters of Sycamore Creek (Ash Creek/Sycamore Creek watershed). The Brown springsnail is limited to Brown Springs (Fossil Creek – lower Verde River watershed). Both of these populations occur on private lands, though forest activities have some level of impacts on their habitat. The Maricopa tiger beetle has greater distribution across the watershed but its status is not well known.

**Table 10. Native fish & aquatic species occurrence on the Prescott NF**

HUC 5 Watershed Name	Colorado pikeminnow	Desert pupfish <sup>1</sup>	Desert sucker	Loach minnow <sup>1</sup>	Longfin dace	Gila chub	Gila topminnow <sup>1</sup>	Gila trout	Headwater chub <sup>1</sup>	Razorback sucker	Roundtail chub	Sonora sucker	Spikedace	Speckled dace	Arizona toad	Lowland leopard frog	Mexican gartersnake	Narrowheaded gartersnake	Maricopa tiger beetle
Muddy Creek																			
Upper Burro Creek			C		C						C				C	C			
Boulder Creek			C		C						C				C	C			
Kirkland Creek			C		C						C				C	C			
Sycamore Creek			C		C						C				C	C			
Lower Partridge Creek																			
Middle Big Chino Wash															C	C			
Williamson Valley Wash						C									C	C			C
Lower Big Chino Wash														C	C	C			C
Granite Creek-Upper Verde River			C		C						C	C	C	C	C		C		C
Hell Canyon																			
Sycamore Creek (Verde River)			C									C			C				
Grindstone Wash-Upper Verde	H		C		C					H	C	C	C	C	C		C	C	C
Cherry Creek-Upper Verde River	H		C	H	C					H	C	C	H	C	C		C	C	C
Fossil Creek-Lower Verde River	H/I		C	H/I	C		H/I	H	C	H/I	C	C	H/I	C	C	C	C	C	C
Ash Creek and Sycamore Creek			C		C	C	H							C	C	C	H		
Big Bug Creek-Agua Fria River								I							C	C			
Black Canyon Creek			C		C										C				
Bishop Creek		C	C		C	C	C								C	C			
Agua Fria River-Lake Pleasant															C				
Upper Hassayampa River			C		C										C	C			
Middle Hassayampa River																			

Source: Arizona Statewide Freshwater Assessment ([www.azconservation.org](http://www.azconservation.org))

Footnote 1: These species do not occur in the planning area.

Legend: C = Current; H = Historical; I = Introduced.

## Species Distribution and Status

### Gila chub

Gila chub was listed as endangered with designated critical habitat in 2005 (U.S. Fish and Wildlife Service 2005). No Recovery Plan has been completed for this species. Gila chub were historically found throughout the Gila River basin in southern Arizona, southwestern New Mexico, and northeastern Sonora, Mexico. The Gila chub has been reduced in numbers and distribution in the majority of its historical range. Where it is still present, populations are often small, fragmented, and at risk from known and potential threats and from random events such as drought, flood events, and wildfire. The primary threats to Gila chub include predation by and competition with non-native organisms, including fish, bullfrogs, and crayfish; and habitat degradation from surface water diversions and ground water withdrawals.

Gila chub commonly inhabit pools in smaller streams, cienegas, and artificial impoundments ranging in elevation from 2,000 to 5,500 feet. Gila chub are highly secretive, preferring quiet deeper waters, especially pools, or remaining near cover including terrestrial vegetation, boulders, and fallen logs. Adults are often found in deep pools and eddies below areas with swift currents. Young-of-the-year inhabit shallow water among plants or debris, while older juveniles use higher velocity stream areas. Gila chub probably mature in their second to third year. Spawning typically occurs from late spring into summer over beds of submerged vegetation or root wads (Weedman and others 1996). Gila chub feed primarily on aquatic insects and algae.

Historical and current distribution and status of Gila chub on the Prescott NF is shown in Table 11. The species is known to occur in Sycamore, Little Sycamore, and Indian creeks in the Agua Fria River drainage (Bettaso and others 1995, Weedman and others 1996, Sillas 2003, 2005, 2006). All three streams have perennial-interrupted flow and thus provide less occupied habitat than available on the forest. There is limited direct impact to Gila chub and their habitat from management activities because of exclosures around occupied sites or rough terrain that restricts access to the stream. Trends in species population and habitat for each stream have declined from historical levels because of the introduction and spread of non-native aquatic species which are predatory and/or competitive with the native species and recently because of wildfire that reduced habitat quantity and quality from excess sedimentation filling in pool habitats.

**Table 11. Gila chub distribution and status on the Prescott NF**

HUC 5 Watershed Name	Stream Name	Stream Miles On Forest	Miles of occupied habitat	Historical Presence	Current Presence
Ash Creek and Sycamore Creek	Sycamore Creek	7	3	Yes	Yes
Ash Creek and Sycamore Creek	Little Sycamore Creek	0.25	0.25	Yes	Yes
Bishop Creek	Indian Creek	0.5	0.5	Yes	Yes

### **Gila chub Critical Habitat**

The final designation of critical habitat includes seven river areas with a total of 160.3-miles of stream reaches in Arizona and New Mexico (USFWS 2005). A total of 19.5-miles of critical habitat occur in Sycamore Creek (11.4 miles), Little Sycamore Creek (2.9 miles), and Indian Creek (5.2 miles) in the Agua Fria River drainage on or adjacent to the Prescott NF. All three streams have perennial-interrupted flow and thus provide less available habitat than designated on the forest. Land ownership is primarily forestlands but there are private land inclusions along all stream systems. Primary constituent elements of critical habitat include perennial pool habitat, suitable water temperature and water quality, adequate food base, sufficient cover and a healthy intact riparian vegetation community, habitat devoid of non-native aquatic species or levels that allow for Gila chub persistence, and a natural stream flow including periodic flooding. All elements of critical habitat are considered to be present within these stream systems except for presence of non-native species that are at levels that are negatively impacting this species.

### **Gila topminnow**

Historically, the Gila topminnow was abundant in the Gila River drainage and was one of the most common fishes of the Colorado River basin, particularly in the Santa Cruz system (USFWS 1999). It occurs in small streams, springs, and cienegas below 4,500 foot elevation. The Gila topminnow is restricted to 14 natural localities in Arizona, mostly in the Santa Cruz River drainage. As part of recovery actions, more than 200 reintroductions have occurred at 175 wild locations. Only eighteen wild populations remained as of 1997. Primary threats to the species and their habitat include the introduction and spread of non-native predatory and competitive fishes, water impoundment and diversion, water pollution, groundwater pumping, stream channelization, and habitat modification.

Historically, there were no documented occurrences of Gila topminnow within the forest (USFWS 1999). Twenty-four sites on the forest were introduced with topminnows in the early 1980's (USFWS 1985). All sites failed to maintain surviving populations (AGFD 2003). Reasons for failure included drying of sites, flooding impacts, reduction of suitable habitat due to vegetation overgrowth, and cold temperatures. Potential habitats on the forest need to be assessed for those sites that meet habitat criteria for possible reintroduction.

### **Razorback sucker**

The razorback sucker is endemic to the Colorado River Basin of Wyoming, Colorado, Utah, New Mexico, Arizona, and California. Wild populations exist only in the Colorado River. Populations in the lower basin were extirpated. Introduction of razorback sucker have occurred within the Verde and Salt Rivers in Arizona. Habitats include slow areas, backwaters, and eddy of medium to large rivers and impoundments. Threats to the species include streamflow regulation, habitat modification, competition with and predation by non-native fish species, and pesticides and pollutants.

Historical and current distribution and status of the Razorback sucker on the Prescott NF is shown in Table 12. Introductions made into main channels habitats of the Verde River since 1981 have had low survival and recruitment has not been documented (Hendrickson 1993, Hyatt 2004).

Since 1994, almost all reintroductions have occurred in the Verde Wild & Scenic River below Camp Verde. The extent of occupied habitat on the Prescott NF is 16 miles in the lower Verde River. Recently, Stillman Lake at the headwaters to the Verde River is scheduled for renovating using piscicides and mechanical removal of non-native fishes for the purpose of reintroducing razorback sucker into this reach of the river (USFWS 2009). However, non-native fish populations are well established throughout the Verde River and are a primary threat to all native fishes from predation and competition. No livestock grazing is authorized along the Verde River on forestlands. Road and trail access and related recreational use of the Verde River on forestlands is limited to just a few river access points with the majority occurring in the Verde Valley. Tamarisk treatments have been completed along the upper and lower Verde River as part of the Noxious Weed Treatment Plan (Forest Service 2004) in recent years to improve riparian and aquatic conditions. Trends in species population and habitat in the Verde River have decreased from historical levels because of the introduction and establishment of non-native aquatic species which are predatory and/or competitive with the native species and reduced habitat quantity and quality from water diversions, nutrient enrichment from agricultural practices, excess sedimentation from land development in the watersheds, and introduction and establishment of noxious plant species.

**Table 12. Razorback sucker distribution and status on the Prescott NF**

<b>HUC 5 Watershed Name</b>	<b>Stream Name</b>	<b>Stream Miles On Forest</b>	<b>Miles of occupied habitat</b>	<b>Historical Presence</b>	<b>Current Presence</b>
Granite Creek-Upper Verde River	Verde River	4	0	Yes	Extirpated
Grindstone Wash-Upper Verde River	Verde River	28	0	Yes	Extirpated
Cherry Creek-Upper Verde River	Verde River	3.4	0	Yes	Extirpated
Fossil Creek-Lower Verde River	Verde River	15.5	16 (local near stocking sites)	Yes	Introduced

### **Razorback sucker Critical Habitat**

Designated critical habitat includes portions of the Colorado, Duchesne, Green, Gunnison, San Juan, White, and Yampa rivers in the Upper Colorado River Basin, and the Colorado, Gila, Salt, and Verde rivers in the Lower Colorado River Basin (USFWS 1994). Critical habitat is designated for about 122 miles of the Verde River and its 100-year floodplain from the U.S. Forest Service boundary (Prescott National Forest) in T.18N., R.2E., sec. 31 to Horseshoe Dam in T.7N., R.6E., sec. 2 (Gila and Salt River Meridian), including Horseshoe Lake to the full pool elevation. About 70 miles of critical habitat occurs on and adjacent to the Prescott NF from Perkinsville downstream to the forest boundary below Camp Verde. The uppermost 15-miles of river are within FS ownership. The next 40 mile reach of river in the Verde Valley is primarily within private ownership. The lowermost 15-miles is again in FS ownership. Primary constituent elements of critical habitat includes a quantity of water of sufficient quality delivered within a

natural hydrologic regime; physical habitat for use in spawning, nursery, feeding, and rearing, or corridors between these areas; adequate food supply and areas with few introduced non-native fish species. All elements of critical habitat are considered to be present within the Verde River, except for presence of non-native species that are at levels that are negatively impacting this species.

## Loach minnow

The loach minnow is endemic to the Gila River Basin of New Mexico, Arizona, and northern Mexico. They are found in small to large perennial streams and use shallow, turbulent riffles with primarily cobble substrate and swift currents. It is rare or absent from habitats where fine sediments fill these interstitial spaces. Loach minnow are now restricted to portions of the upper Gila River, San Francisco River, and Tularosa River in New Mexico; and Blue River, Aravaipa Creek, Eagle Creek, and the Black River in Arizona. The present range is 15 to 20 percent of its historical range, and the status of the species within occupied areas ranges from common to very rare. Threats to the species include habitat modification and destruction from water diversions, improper livestock grazing, etc. and presence of non-native fish species which are predatory and/or compete with the species (USFWS 2007).

Historical and current distribution and status of the loach minnow on the Prescott NF is shown in Table 13. Historically, the loach minnow was collected in the Verde River above Camp Verde and from Beaver Creek near its confluence with the Verde River in 1938 (Minckley 1993). The loach minnow is extirpated from the Verde River (USFWS 2000). Non-native fish populations are well established throughout the Verde River and are a primary threat to all native fishes from predation and competition. No livestock grazing is authorized along the Verde River on forestlands. Road and trail access and related recreational use of the Verde River on forestlands is limited to just a few river access points with the majority occurring in the Verde Valley. Tamarisk treatments have been completed along the upper and lower Verde River as part of the Noxious Weed Treatment Plan (Forest Service 2004) in recent years to improve riparian and aquatic conditions. Trends in species population and habitat in the Verde River have decreased from historical levels because of the introduction and establishment of non-native aquatic species which are predatory and/or competitive with the native species and reduced habitat quantity and quality from water diversions, nutrient enrichment from agricultural practices, excess sedimentation from land development in the watersheds, and introduction and establishment of noxious plant species.

**Table 13. Loach minnow distribution and status on the Prescott NF**

HUC 5 Watershed Name	Stream Name	Stream Miles On Forest	Miles of occupied habitat	Historical Presence	Current Presence
Granite Creek-Upper Verde River	Verde River	4	0	Unknown	Extirpated
Grindstone Wash-Upper Verde River	Verde River	28	0	Unknown	Extirpated
Cherry Creek-Upper Verde River	Verde River	3.4	0	Yes	Extirpated

<b>HUC 5 Watershed Name</b>	<b>Stream Name</b>	<b>Stream Miles On Forest</b>	<b>Miles of occupied habitat</b>	<b>Historical Presence</b>	<b>Current Presence</b>
Fossil Creek-Lower Verde River	Verde River	15.5	0	Yes	Extirpated

### **Loach minnow Critical habitat**

Critical habitat for the loach minnow includes 709 miles of stream systems and adjacent floodplain within 300 lateral feet on either side of bankfull stage within New Mexico and Arizona (USFWS 2010). There are about 136 miles of designated critical habitat on the Verde River and its tributaries Granite Creek, Oak Creek, Beaver/Wet Beaver Creek, West Clear Creek, and Fossil Creek. A total of about 74 miles of designated critical habitat occurs on the Verde River from the confluence with Beaver Creek upstream to Sullivan Dam. The uppermost 43-miles of river are primarily within FS ownership. The next 31 miles of river in the Verde Valley is primarily within private ownership. Physical and biological features of loach minnow critical habitat includes habitat to support all life stage for the species such as perennial flow and appropriate stream microhabitat types; an abundant aquatic insect food base; streams with no or low levels of pollutants; stream courses with connective corridors between occupied and seasonally occupied habitat; no non-native aquatic species or levels that are sufficiently low to as to allow persistence of the species; and streams with a natural unregulated flow regime that allows for periodic flooding or where modified that allows for adequate river function. All physical and biological features of designated critical habitat are considered to be present within the Verde River, except for levels of non-native aquatic species that would allow for persistence of loach minnow.

### **Spikedace**

Historically, spikedace were common and locally abundant throughout the upper Gila River basin of Arizona and New Mexico. Spikedace are found in moderate to large perennial streams from 1,620 to 4,500 foot elevation, where they inhabit shallow riffles with sand, gravel, and rubble substrates. Recurrent flooding and a natural flow regime are very important in maintaining the habitat of spikedace and in helping maintain a competitive edge over invading non-native aquatic species. Spikedace are now restricted to portions of the upper Gila River in New Mexico; and Aravaipa Creek, Eagle Creek, and the Verde River in Arizona. It is estimated that the spikedace present range is approximately 10 percent or less of its historical range, and the status of the species within occupied areas ranges from common to very rare. Threats to the species include habitat modification and destruction from water diversions, improper livestock grazing, etc. and presence of non-native fish species which are predatory and/or compete with the species (USFWS 2007).

Historical and current distribution and status of the spikedace on the Prescott NF is shown in Table 14. Historically, spikedace were collected in the Verde River above Camp Verde and the lower ends of Beaver Creek and West Clear Creek in 1938, and in the Verde River above Camp Verde in 1950 (Minckley 1993). The species was first collected in the upper Verde River in the 1970's (Girmendonk and Young 1997). Currently, spikedace are considered rare or may be extirpated in the upper 32 miles of the Verde River on the forest based on extensive surveys (AFGD 2001a-b, 2005a-c, Bahm and Robinson 2009, Robinson and Crowder 2009, Forest

Service 2010; USFWS 2005). It has not been collected since 1997. Spikedace populations are extirpated from the lower Verde River in the Verde Valley (USFWS 2007). Non-native fish populations are well established throughout the Verde River and are a primary threat to all native fishes from predation and competition. No livestock grazing is authorized along the Verde River on forestlands. Road and trail access and related recreational use of the Verde River on forestlands is limited to just a few river access points with the majority occurring in the Verde Valley. Tamarisk treatments have been completed along the upper and lower Verde River as part of the Noxious Weed Treatment Plan (Forest Service 2004) in recent years to improve riparian and aquatic conditions. Trends in species population and habitat in the Verde River have decreased from historical levels because of the introduction and establishment of non-native aquatic species which are predatory and/or competitive with the native species and reduced habitat quantity and quality from water diversions, nutrient enrichment from agricultural practices, excess sedimentation from land development in the watersheds, and introduction and establishment of noxious plant species.

**Table 14. Spikedace distribution and status on the Prescott NF**

<b>HUC 5 Watershed Name</b>	<b>Stream Name</b>	<b>Stream Miles On Forest</b>	<b>Miles of occupied habitat</b>	<b>Historical Presence</b>	<b>Current Presence</b>
Granite Creek-Upper Verde River	Verde River	4	4	Yes	Rare or extirpated
Grindstone Wash-Upper Verde River	Verde River	28	28	Yes	Rare or extirpated
Cherry Creek-Upper Verde River	Verde River	3.4	0	Yes	Extirpated
Fossil Creek-Lower Verde River	Verde River	15.5	0	Yes	Extirpated

### **Spikedace Critical habitat**

Designated critical habitat for the spikedace includes 175 miles of stream systems and adjacent floodplain within 300 lateral feet on either side of bankfull stage within New Mexico and Arizona (USFWS 2010). There are about 175 miles of designated critical habitat on the Verde River and its tributaries Granite Creek, Oak Creek, Beaver/Wet Beaver Creek, West Clear Creek, and Fossil Creek. A total of about 107 miles of designated critical habitat occurs on the Verde River from the confluence with Fossil Creek upstream to Sullivan Dam. The uppermost 43-miles of river are primarily within FS ownership. The next 40 miles of river in the Verde Valley is primarily within private ownership. The lowermost 24 miles are again with FS ownership. Physical and biological features of spikedace critical habitat includes habitat to support all life stage for the species such as perennial flow and appropriate stream microhabitat types; an abundant aquatic insect food base; streams with no or low levels of pollutants; stream courses with connective corridors between occupied and seasonally occupied habitat; no non-native aquatic species or levels that are sufficiently low to as to allow persistence of the species; and streams with a natural unregulated flow regime that allows for periodic flooding or where modified that allows for adequate river function. All physical and biological features of designated critical habitat are

considered to be present within the Verde River, except for levels of non-native aquatic species that would allow for persistence of spikedace.

## Gila trout

The Gila trout is endemic to the Gila River Basin of New Mexico and Arizona and is found in moderate- to high-gradient perennial mountain streams above 5,400 feet to over 9,200 feet elevation. Currently, there are 16 populations of Gila trout in the wild (USFWS 2003, AGFD 2009). Primary threats to Gila trout include hybridization, competition, and/or predation by non-native trout species, habitat degradation, and wildfire.

Historical and current distribution and status of Gila trout on the Prescott NF is shown in Table 15. Historically, there were no naturally occurring Gila trout populations on the forest. Gap Creek, a tributary to the Verde River, was introduced with trout in 1974. This population persisted until 1990 but was extirpated presumably due to drought (AGFD 1992). It was recommended not to restock this stream because of the inconsistency of stream flows (AGFD 1992). Recently, Gila trout were introduced into Grapevine Creek in 2009 (AGFD 2009). No livestock grazing is authorized within occupied habitat in the Grapevine Botanical Area (Forest Service 1997). Recreation use is restricted to Day use only. Forest Trail #4 parallels the creek though has low use. There is no motorized or mountain bike use of trails within the botanical area

**Table 15. Gila trout distribution and status on the Prescott NF**

HUC 5 Watershed Name	Stream Name	Stream Miles On Forest	Miles of Occupied habitat	Historical Presence	Current Presence
Big Bug Creek	Grapevine Creek	1	1	No	Yes
Fossil Creek – Lower Verde River	Gap Creek	1.5	0	No	Extirpated

## Colorado pikeminnow

The Colorado pikeminnow is endemic to the Colorado River Basin of Wyoming, Colorado, Utah, New Mexico, Arizona, and California. Wild populations exist only in the upper basin above Glen Canyon Dam. Populations in the lower basin were extirpated. Introduction of pikeminnow have occurred within the Verde and Salt Rivers in Arizona as “experimental non-essential” under Section 10J of the Endangered Species Act (USFWS 1985). Colorado pikeminnow is adapted to life in big river systems that are highly variable, with extremes in flow and turbidity. Habitat includes pools, deep runs, and eddies of medium to large rivers. Threats to the species include streamflow regulation, habitat modification, competition with and predation by non-native fish species, and pesticides and pollutants.

Historical and current distribution and status of the Colorado pikeminnow on the Prescott NF is shown in Table 16. Introductions made into main channels habitats of the Verde River since 1985 have had low survival and recruitment has not been documented (Hendrickson 1993, Hyatt 2004). Since 1994, almost all reintroductions have occurred in the Verde Wild & Scenic River below

Camp Verde. Non-native fish populations are well established throughout the Verde River and are a primary threat to all native fishes from predation and competition. No livestock grazing is authorized along the Verde River on forestlands. Road and trail access and related recreational use of the Verde River on forestlands is limited to just a few river access points with the majority occurring in the Verde Valley. Tamarisk treatments have been completed along the upper and lower Verde River as part of the Noxious Weed Treatment Plan (Forest Service 2004) in recent years to improve riparian and aquatic conditions. Trends in species population and habitat in the Verde River have decreased from historical levels because of the introduction and establishment of non-native aquatic species which are predatory and/or competitive with the native species and reduced habitat quantity and quality from water diversions, nutrient enrichment from agricultural practices, excess sedimentation from land development in the watersheds, and introduction and establishment of noxious plant species.

**Table 16. Colorado pikeminnow distribution and status on the Prescott NF**

<b>HUC 5 Watershed Name</b>	<b>Stream Name</b>	<b>Stream Miles On Forest</b>	<b>Miles of occupied habitat</b>	<b>Historical Presence</b>	<b>Current Presence</b>
Grindstone Wash-Upper Verde River	Verde River	28	0	Yes	Extirpated
Cherry Creek-Upper Verde River	Verde River	3.4	0	Yes	Extirpated
Fossil Creek-Lower Verde River	Verde River	15.5	16 (local near stocking sites)	Yes	Introduced

## Roundtail chub

Roundtail chubs are found in cool to warmwater, mid-elevation rivers and streams throughout the Colorado River Basin, often occupying open areas of the deepest pools and eddies on middle-sized to larger streams (Voeltz 2002). Current range includes areas varying in elevation from approximately 1,210 to 7,220 feet although more commonly found between 2,000 - 5,000 feet. Habitats occupied by roundtail chubs are often associated with adjacent cover in the form of boulders, overhanging cliffs, undercut banks, or vegetation. Threats to the species include habitat modification or degradation from water diversions, groundwater pumping, dewatering, mining, contaminants, urban and agricultural development, and livestock grazing; and predation and competition by non-native aquatic species (USFWS 2009).

Historical and current distribution and status of the roundtail chub on the Prescott NF is shown in Table 17. Populations are found in the Verde River mainstem throughout the forest (AGFD 2003, 2009; Voeltz 2002). Non-native fish populations are well established throughout the Verde River and are a primary threat to all native fishes from predation and competition. No livestock grazing is authorized along the Verde River on forestlands. Road and trail access and related recreational use of the Verde River on forestlands is limited to just a few river access points with the majority occurring in the Verde Valley. Tamarisk treatments have been completed along the upper and lower Verde River as part of the Noxious Weed Treatment Plan (Forest Service 2004) in recent

years to improve riparian and aquatic conditions. Trends in species population and habitat in the Verde River have decreased from historical levels because of the introduction and establishment of non-native aquatic species which are predatory and/or competitive with the native species and reduced habitat quantity and quality from water diversions, nutrient enrichment from agricultural practices, excess sedimentation from land development in the watersheds, and introduction and establishment of noxious plant species.

**Table 17. Roundtail chub distribution and status on the Prescott NF**

<b>HUC 5 Watershed Name</b>	<b>Stream Name</b>	<b>Stream Miles On Forest</b>	<b>Miles of occupied habitat</b>	<b>Historical Presence</b>	<b>Current Presence</b>
Granite Creek-Upper Verde River	Verde River	4	4	Yes	Yes
Grindstone Wash-Upper Verde River	Verde River	28	28	Yes	Yes
Cherry Creek-Upper Verde River	Verde River	3.4	3.4	Yes	Yes
Fossil Creek-Lower Verde River	Verde River	15.5	15.5	Yes	Yes

## **Desert sucker**

Species occur in the Bill Williams, Salt, Gila, and San Francisco River drainages in the lower Colorado River Basin within Utah, Nevada, Arizona, and New Mexico (AGFD 2002, NatureServe 2008). Found in rapids and flowing pools of streams and rivers primarily over bottoms of gravel-rubble with sandy silt in the interstices. Elevation ranges from 480 to 8,840 feet. Threats to the species and their habitats include introduction and spread of non-native aquatic species and habitat destruction from a variety of human activities

Historical and current distribution and status of the desert sucker on the Prescott NF is shown in Table 18. The species occurs in numerous streams in the planning area (Bettaso and others 1995, Rinne 1998, AGFD 2003, 2009; Desert Fishes Team 2004). Currently, population abundance in the Verde River is being negatively impacted due to non-native predatory fishes (Rinne 2001, Bonar and others 2004). No livestock grazing is authorized along the Verde River on forestlands. Road and trail access and related recreational use of the Verde River on forestlands is limited to just a few river access points with the majority occurring in the Verde Valley. Tamarisk treatments have been completed along the upper and lower Verde River as part of the Noxious Weed Treatment Plan (Forest Service 2004) in recent years to improve riparian and aquatic conditions. Species abundance in other streams across the forest is influenced by the amount of available habitat in these intermittent or perennial-interrupted streams and also by presence of non-native aquatic species. Placer mining activities are a regular occurrence in the Hassayampa, Big Bug Creek, and Turkey Creek drainages. Trends in population and habitat in the Verde River and other streams have decreased from historical levels because of the introduction and establishment of non-native aquatic species which are predatory and/or competitive with the native species and reduced habitat quantity and quality from water diversions, nutrient

enrichment from agricultural practices, excess sedimentation from land development in the watersheds, and introduction and establishment of noxious plant species.

**Table 18. Desert sucker distribution and status on the Prescott NF**

<b>HUC 5 Watershed Name</b>	<b>Stream Name</b>	<b>Stream Miles On Forest</b>	<b>Miles of occupied habitat</b>	<b>Historical Presence</b>	<b>Current Presence</b>
Granite Creek-Upper Verde River	Verde River	4	4	Yes	Yes
Grindstone Wash-Upper Verde River	Verde River	28	28	Yes	Yes
Cherry Creek-Upper Verde River	Verde River	3.4	3.4	Yes	Yes
Fossil Creek-Lower Verde River	Verde River	15.5	15.5	Yes	Yes
Sycamore Creek	Sycamore Creek	1	1	Yes	Yes
Ash Creek and Sycamore Creek	Sycamore Creek	7	3	Yes	Yes
Ash Creek and Sycamore Creek	Little Sycamore Creek	0.25	0.25	Yes	Yes
Ash Creek and Sycamore Creek	Little Ash Creek	3	3	Yes	Yes
Ash Creek and Sycamore Creek	Dry Creek	0.5	0.5	Yes	Yes
Bishop Creek	Indian Creek	0.5	0.5	Yes	Yes
Big Bug Creek – Agua Fria River	Big Bug Creek	2	Unknown	Yes	Yes
Upper Hassayampa River	Hassayampa River	6	Unknown	Yes	Yes
Upper Hassayampa River	Blind Indian Creek	1	Unknown	Yes	Yes
Upper Hassayampa River	Cellar Springs Creek	1	Unknown	Yes	Yes
Upper Hassayampa River	Milk Creek	1	Unknown	Yes	Yes

## Longfin dace

The longfin dace occurs in the Lower Colorado River Basin (primarily Gila and Bill Williams river drainages) in Arizona and New Mexico and south into Mexico (AGFD 2006, NatureServe 2008). This species is wide ranging, from intermittent hot low-desert streams to clear and cool brooks at higher elevations. They are rarely abundant in large streams or above 5,000 feet. Threats to the species and their habitats include introduction and spread of non-native aquatic species and habitat destruction from a variety of human activities

Historical and current distribution and status of the longfin dace on the Prescott NF is shown in Table 19. The species occurs in numerous streams in the planning area (Bettaso and others 1995, Rinne 1998, AGFD 2003, 2009; Desert Fishes Team 2004). Currently, population abundance in the Verde River is being negatively impacted due to non-native predatory fishes (Rinne 2001, Bonar and others 2004). No livestock grazing is authorized along the Verde River on forestlands. Road and trail access and related recreational use of the Verde River on forestlands is limited to just a few river access points with the majority occurring in the Verde Valley. Tamarisk treatments have been completed along the upper and lower Verde River as part of the Noxious Weed Treatment Plan (Forest Service 2004) in recent years to improve riparian and aquatic conditions. Species abundance in other streams across the forest is influenced by the amount of available habitat in these intermittent or perennial-interrupted streams and also by presence of non-native aquatic species. Placer mining activities are a regular occurrence in the Hassayampa, Big Bug Creek, and Turkey Creek drainages. Trends in population and habitat in the Verde River and other streams have decreased from historical levels because of the introduction and establishment of non-native aquatic species which are predatory and/or competitive with the native species and reduced habitat quantity and quality from water diversions, nutrient enrichment from agricultural practices, excess sedimentation from land development in the watersheds, and introduction and establishment of noxious plant species.

**Table 19. Longfin dace distribution and status on the Prescott NF**

<b>HUC 5 Watershed Name</b>	<b>Stream Name</b>	<b>Stream Miles On Forest</b>	<b>Miles of occupied habitat</b>	<b>Historical Presence</b>	<b>Current Presence</b>
Granite Creek-Upper Verde River	Verde River	4	4	Yes	Yes
Grindstone Wash-Upper Verde River	Verde River	28	28	Yes	Yes
Cherry Creek-Upper Verde River	Verde River	3.4	3.4	Yes	Yes
Fossil Creek-Lower Verde River	Verde River	15.5	15.5	Yes	Yes
Sycamore Creek	Sycamore Creek	1	1	Yes	Yes
Ash Creek and Sycamore Creek	Cienega Creek	6	1	Yes	Yes
Ash Creek and Sycamore Creek	Sycamore Creek	10	3	Yes	Yes
Ash Creek and Sycamore Creek	Little Sycamore Creek	1	0.25	Yes	Yes
Ash Creek and Sycamore Creek	Little Ash Creek	3	3	Yes	Yes
Ash Creek and Sycamore Creek	Dry Creek	0.5	0.5	Yes	Yes
Bishop Creek	Indian Creek	0.5	0.5	Yes	Yes
Big Bug Creek – Agua Fria River	Big Bug Creek	2	Unknown	Yes	Yes

HUC 5 Watershed Name	Stream Name	Stream Miles On Forest	Miles of occupied habitat	Historical Presence	Current Presence
Upper Hassayampa River	Hassayampa River	6	Unknown	Yes	Yes
Upper Hassayampa River	Blind Indian Creek	1	Unknown	Yes	Yes
Upper Hassayampa River	Cellar Springs Creek	1	Unknown	Yes	Yes
Upper Hassayampa River	Milk Creek	1	Unknown	Yes	Yes

### Sonora sucker

This species occurs in the Gila and Bill Williams river basins of Arizona and New Mexico, and in Gila basin of northern Sonora, Mexico (NatureServe 2008; AGFD 2002). The Sonora sucker is found in a variety of habitats from warm water rivers to trout streams from 1,210 to 8,730 foot elevations. Threats to the species and their habitats include introduction and spread of non-native aquatic species and habitat destruction from a variety of human activities

Historical and current distribution and status of the Sonora sucker on the Prescott NF is shown in Table 20. Populations are found in the Verde River mainstem throughout the forest (AGFD 2003, 2009; Voeltz 2002). Non-native fish populations are well established throughout the Verde River and are a primary threat to all native fishes from predation and competition. No livestock grazing is authorized along the Verde River on forestlands. Road and trail access and related recreational use of the Verde River on forestlands is limited to just a few river access points with the majority occurring in the Verde Valley. Tamarisk treatments have been completed along the upper and lower Verde River as part of the Noxious Weed Treatment Plan (Forest Service 2004) in recent years to improve riparian and aquatic conditions. Trends in population and habitat in the Verde River have decreased from historical levels because of the introduction and establishment of non-native aquatic species which are predatory and/or competitive with the native species and reduced habitat quantity and quality from water diversions, nutrient enrichment from agricultural practices, excess sedimentation from land development in the watersheds, and introduction and establishment of noxious plant species.

**Table 20. Sonora sucker distribution and status on the Prescott NF**

HUC 5 Watershed Name	Stream Name	Stream Miles On Forest	Miles of occupied habitat	Historical Presence	Current Presence
Granite Creek-Upper Verde River	Verde River	4	4	Yes	Yes
Grindstone Wash-Upper Verde River	Verde River	28	28	Yes	Yes
Cherry Creek-Upper Verde River	Verde River	3.4	3.4	Yes	Yes

HUC 5 Watershed Name	Stream Name	Stream Miles On Forest	Miles of occupied habitat	Historical Presence	Current Presence
Fossil Creek-Lower Verde River	Verde River	15.5	15.5	Yes	Yes

## Speckled dace

The speckled dace is native to all major western drainages from the Columbia and Colorado rivers south to Sonora, Mexico (AGFD 2002, NatureServe 2008). Occurs in many kinds of habitats: riffles, runs, and pools of cool flowing headwaters, creeks, and rivers with mostly rocky substrates; large and small lakes (rarely); warm, permanent and intermittent streams; and outflows of desert springs. A bottom dweller, found in rocky riffles, runs, and pools of headwaters, creeks, and small to medium rivers: rarely in lakes. Peak abundance is found from 6562 - 9843 feet, rarely below 4921 feet. Threats to the species and their habitats include introduction and spread of non-native aquatic species and habitat destruction from a variety of human activities

Historical and current distribution and status of the speckled dace on the Prescott NF is shown in Table 21. The species occurs in numerous streams in the planning area (Bettaso and others 1995, Rinne 1998, AGFD 2003, 2009; Desert Fishes Team 2004). Currently, population abundance in the Verde River is being negatively impacted due to non-native predatory fishes (Rinne 2001, Bonar and others 2004). No livestock grazing is authorized along the Verde River on forestlands. Road and trail access and related recreational use of the Verde River on forestlands is limited to just a few river access points with the majority occurring in the Verde Valley. Tamarisk treatments have been completed along the upper and lower Verde River as part of the Noxious Weed Treatment Plan (Forest Service 2004) in recent years to improve riparian and aquatic conditions. Species abundance in other streams across the forest is influenced by the amount of available habitat in these intermittent or perennial-interrupted streams and also by presence of non-native aquatic species. Trends in population and habitat in the Verde River and other streams have decreased from historical levels because of the introduction and establishment of non-native aquatic species which are predatory and/or competitive with the native species and reduced habitat quantity and quality from water diversions, nutrient enrichment from agricultural practices, excess sedimentation from land development in the watersheds, and introduction and establishment of noxious plant species.

**Table 21. Speckled dace distribution and status on the Prescott NF**

HUC 5 Watershed Name	Stream Name	Stream Miles On Forest	Miles of occupied habitat	Historical Presence	Current Presence
Lower Big Chino Wash	Walnut Creek	0.5	0.5	Yes	Yes
Granite Creek-Upper Verde River	Verde River	4	4	Yes	Yes

<b>HUC 5 Watershed Name</b>	<b>Stream Name</b>	<b>Stream Miles On Forest</b>	<b>Miles of occupied habitat</b>	<b>Historical Presence</b>	<b>Current Presence</b>
Grindstone Wash-Upper Verde River	Verde River	28	28	Yes	Yes
Cherry Creek-Upper Verde River	Verde River	3.4	3.4	Yes	Yes
Fossil Creek-Lower Verde River	Verde River	15.5	15.5	Yes	Yes
Ash Creek and Sycamore Creek	Sycamore Creek	7	3	Yes	Yes
Ash Creek and Sycamore Creek	Little Sycamore Creek	0.25	0.25	Yes	Yes
Ash Creek and Sycamore Creek	Little Ash Creek	3	3	Yes	Yes

## **Mexican gartersnake**

The Mexican gartersnake ranges from west-central Veracruz, Mexico north along the Sierra Madre Occidental to central Arizona and west central New Mexico at elevations ranging from about 200 feet up to 8500 feet (ref.). In Arizona, these snakes are most abundant in densely vegetated habitat surrounding cienegas, cienega-streams, and stock tanks and in or near water along streams in valley floors and generally open areas, but not in steep mountain canyon stream habitat (AGFD 2001). Most localities are between 3000 and 5000 feet elevation in aquatic systems of desert grassland plant communities (Rosen and Schwalbe 1988). This species preys primarily on frogs, tadpoles, and native fish. Threats to the species include predation by introduced bullfrogs and predatory fishes, urbanization and lowered water tables, and habitat destruction, including that due to overgrazing. Population numbers are decreasing, with extirpations at several localities since 1950 as habitat is changed and introduced predators invade habitat.

Historical and current distribution and status of the Mexican gartersnake on the Prescott NF is shown in Table 22. Historically, this species is known from along the Verde River and Little Ash Creek on the forest (Rosen and Schwalbe 1988). A few specimens have been collected in recent years along the Verde River on and adjacent to the Prescott NF (Holycross and others 2006). Populations are considered to be at low densities in the Verde River. No livestock grazing is authorized along the Verde River on forestlands. Non-native fish populations, bullfrogs, and crayfish are well established throughout the Verde River and are a primary threat to these reptiles from predation. Trends in population and habitat in the Verde River and other streams have decreased from historical levels because of the introduction and establishment of non-native aquatic species which are predatory and/or competitive with the native species and reduced habitat quantity and quality from water diversions, nutrient enrichment from agricultural practices, excess sedimentation from land development in the watersheds, and introduction and establishment of noxious plant species.

**Table 22. Mexican gartersnake distribution and status on the Prescott NF**

<b>HUC 5 Watershed Name</b>	<b>Stream Name</b>	<b>Stream Miles On Forest</b>	<b>Miles of occupied habitat</b>	<b>Historical Presence</b>	<b>Current Presence</b>
Granite Creek-Upper Verde River	Verde River	4	0	Unknown	Unknown
Grindstone Wash-Upper Verde River	Verde River	28	28	Yes	Yes
Cherry Creek-Upper Verde River	Verde River	3.4	3.4	Yes	Yes
Fossil Creek-Lower Verde River	Verde River	15.5	15.5	Yes	Yes
Ash Creek and Sycamore Creek	Little Ash Creek	3	0	Yes	Extirpated

### **Narrow-headed gartersnake**

The Narrow-headed gartersnake occurs from central Arizona to western New Mexico and south to central and western Chihuahua and northern and western Durango, Mexico (NatureServe 2008). In Arizona, this gartersnake is known primarily from streams draining the Mogollon Rim and the White Mountains (AGFD 2009). Most localities are between 4000 and 6000 feet elevation in aquatic systems of Piñon/Juniper, Oak-pine belts, up to ponderosa pine forests (Rosen and Schwalbe 1988). Highly aquatic species, associated with riffle/pool complexes of cool, clear, rocky mountain streams. Narrow-headed are only found in areas of high native fish concentration and primarily consume fish. Threats to this species include loss or reduction of streamflow, habitat modification, grazing along streambeds and increased recreational use in riparian areas. Other threats consist of the introduction of predators, such as bullfrogs and predatory fishes, as well as habitat fragmentation. Population trends show declines in many populations.

Historical and current distribution and status of the narrow-headed gartersnake on the Prescott NF is shown in Table 23. A few specimens have been collected in recent years along the Verde River on and adjacent to the Prescott NF (Holycross and others 2006, Emmons and others 2010 draft). No livestock grazing is authorized along the Verde River on forestlands. Non-native fish populations, bullfrogs, and crayfish are well established throughout the Verde River and are a primary threat to these reptiles from predation. There are no known or historical occurrences within the Agua Fria River drainage (AGFD 2009). Trends in population and habitat in the Verde River have decreased from historical levels because of the introduction and establishment of non-native aquatic species which are predatory and/or competitive with the native species and reduced habitat quantity and quality from water diversions, nutrient enrichment from agricultural practices, excess sedimentation from land development in the watersheds, and introduction and establishment of noxious plant species.

**Table 23. Narrow-headed gartersnake distribution and status on the Prescott NF**

HUC 5 Watershed Name	Stream Name	Stream Miles On Forest	Miles of occupied habitat	Historical Presence	Current Presence
Granite Creek-Upper Verde River	Verde River	4	0	Unknown	Unknown
Grindstone Wash-Upper Verde River	Verde River	28	28	Yes	Yes
Cherry Creek-Upper Verde River	Verde River	3.4	3.4	Yes	Yes
Fossil Creek-Lower Verde River	Verde River	15.5	15.5	Yes	Yes

### Arizona toad

Species occur from southwest Utah and southeast Nevada, and along Mogollon Rim of southwest New Mexico and central Arizona (AGFD 2002, NatureServe 2008)). Usually found along rocky stream courses from desert up to conifer forest, elevations from near sea level to around 8,000 feet. Occur primarily in rocky streams and canyons in the pine-oak belt from about 500 to 8000 feet elevation. Threats include hybridization with woodhouse toad, water diversions and manipulations (e.g. dams), and heavy grazing in riparian areas.

Historical and current distribution and status of the Arizona toad on the Prescott NF is shown in Table 24. This species is known to occur along the Verde River and in the Agua Fria River drainage (Sullivan 1993, Holycross and others 2006, Emmons and others 2010 draft). No livestock grazing is authorized along the Verde River on forestlands. Trends in population and habitat in the Verde River and other streams have decreased from historical levels because of the introduction and establishment of non-native aquatic species which are predatory and/or competitive with the native species, hybridization with the Woodhouse toad, and reduced habitat quantity and quality from water diversions, nutrient enrichment from agricultural practices, excess sedimentation from land development in the watersheds, and introduction and establishment of noxious plant species.

**Table 24. Arizona toad distribution and status on the Prescott NF**

HUC 5 Watershed Name	Stream Name	Stream Miles On Forest	Miles of occupied habitat	Historical Presence	Current Presence
Lower Big Chino Wash	Apache Creek Walnut Creek	0.5	0.5	Yes	Yes
Williamson Valley Wash	Various springs	Unknown	Unknown	Yes	Yes
Granite Creek-Upper Verde River	Verde River	4	4	Yes	Yes

<b>HUC 5 Watershed Name</b>	<b>Stream Name</b>	<b>Stream Miles On Forest</b>	<b>Miles of occupied habitat</b>	<b>Historical Presence</b>	<b>Current Presence</b>
Grindstone Wash-Upper Verde River	Verde River	28	28	Yes	Yes
Cherry Creek-Upper Verde River	Verde River	3.4	3.4	Yes	Yes
Fossil Creek-Lower Verde River	Verde River	15.5	15.5	Yes	Yes
Sycamore Creek	Sycamore Creek	1	1	Yes	Yes
Ash Creek and Sycamore Creek	Cienega Creek	1	1	Yes	Yes
Ash Creek and Sycamore Creek	Sycamore Creek	7	3	Yes	Yes
Ash Creek and Sycamore Creek	Little Sycamore Creek	0.25	0.25	Yes	Yes
Ash Creek and Sycamore Creek	Little Ash Creek	3	3	Yes	Yes
Ash Creek and Sycamore Creek	Dry Creek	0.5	0.5	Yes	Yes
Bishop Creek	Indian Creek	0.5	0.5	Yes	Yes
Big Bug Creek – Agua Fria River	Big Bug Creek	1	1	Yes	Yes
Upper Hassayampa River	Hassayampa River	2	Unknown	Yes	Yes
Upper Hassayampa River	Blind Indian Creek	6	Unknown	Yes	Yes
Upper Hassayampa River	Cellar Springs Creek	1	Unknown	Yes	Yes
Upper Hassayampa River	Milk Creek	1	Unknown	Yes	Yes

### **Lowland leopard frog**

The lowland leopard frog ranges from central and southeastern Arizona below the Mogollon Rim, southwest New Mexico (Gila River and Rio San Francisco), and probably northern Sonora and northwestern Chihuahua, Mexico (AGFD 2006, NatureServe 2008). It is found in small to medium streams, and occurs in small springs, stock ponds, and occasionally in large rivers. This species is generally restricted to permanent waters below elevations of 6,400 feet. The greatest threats to this species are habitat alteration and fragmentation, accentuated by the introduction of non-native predatory and competitive fishes, crayfishes, and bullfrogs.

Historical and current distribution and status of the lowland leopard frog on the Prescott NF is shown in Table 25. Mining impacts to aquatic habitat and water quality have affected the species within the Lynx Creek-Agua Fria River, Upper Hassayampa River, and Black Canyon Creek

HUC5 watersheds. Trends in population and habitat in the Verde River and other streams have decreased from historical levels because of the introduction and establishment of non-native aquatic species which are predatory and/or competitive with the native species and reduced habitat quantity and quality from water diversions, nutrient enrichment from agricultural practices, excess sedimentation from land development in the watersheds, and introduction and establishment of noxious plant species.

**Table 25. Lowland leopard frog distribution and status on the Prescott NF**

<b>HUC 5 Watershed Name</b>	<b>Stream Name</b>	<b>Stream Miles On Forest</b>	<b>Miles of occupied habitat</b>	<b>Historical Presence</b>	<b>Current Presence</b>
Lower Big Chino Wash	Apache Creek Walnut Creek	0.5	0.5	Yes	Yes
Granite Creek- Upper Verde River	Verde River	4	4	Yes	Yes
Grindstone Wash- Upper Verde River	Verde River	28	28	Yes	Yes
Cherry Creek- Upper Verde River	Verde River	3.4	3.4	Yes	Yes
Fossil Creek- Lower Verde River	Verde River	15.5	15.5	Yes	Yes
Sycamore Creek	Sycamore Creek	1	1	Yes	Yes
Ash Creek and Sycamore Creek	Cienega Creek	1	1	Yes	Yes
Ash Creek and Sycamore Creek	Sycamore Creek	7	3	Yes	Yes
Ash Creek and Sycamore Creek	Little Sycamore Creek	0.25	0.25	Yes	Yes
Ash Creek and Sycamore Creek	Little Ash Creek	3	3	Yes	Yes
Ash Creek and Sycamore Creek	Dry Creek	0.5	0.5	Yes	Yes
Ash Creek and Sycamore Creek	Government Spring	0.5	0.5	Yes	Yes
Bishop Creek	Indian Creek	0.5	0.5	Yes	Yes
Big Bug Creek – Agua Fria River	Big Bug Creek	1	1	Yes	Yes
Upper Hassayampa River	Hassayampa River	2	Unknown	Yes	Yes
Upper Hassayampa River	Blind Indian Creek	6	Unknown	Yes	Yes
Upper Hassayampa River	Cellar Springs Creek	1	Unknown	Yes	Yes

HUC 5 Watershed Name	Stream Name	Stream Miles On Forest	Miles of occupied habitat	Historical Presence	Current Presence
Upper Hassayampa River	Milk Creek	1	Unknown	Yes	Yes

### Brown springsnail

Historical and current distribution and status of the Brown springsnail on the Prescott NF is shown in Table 26. The total range of this species is Brown Spring, Yavapai County, Arizona (AGFD 2003). This occurrence is on private lands but with a water diversion to forestlands. Threats include highly restricted distribution with associated potential for extinction due to chance events, water development and groundwater depletion. The population has not been monitored since 1988 so population trends are unknown (AGFD 2003).

**Table 26. Brown springsnail distribution and status on the Prescott NF**

HUC 5 Watershed Name	Stream Name	Stream Miles On Forest	Miles of occupied habitat	Historical Presence	Current Presence
Fossil Creek-Lower Verde River	Brown Spring	0	0.25	Yes	Unknown

### Verde Rim springsnail

Historical and current distribution and status of the Verde Rim springsnail on the Prescott NF is shown in Table 27. The total range of this species is the Nelson Place Spring complex that forms the headwaters of Sycamore Creek, Yavapai County, Arizona (AGFD 2003). This occurrence is on private lands but is not fenced from livestock grazing that is permitted within the Sycamore Allotment. Forest Trail # 159 to Pine Mountain Wilderness passes through the spring habitat. Threats include highly restricted distribution with associated potential for extinction due to chance events, wildfire, improper livestock grazing, and recreational activities. A site visit in September 2010 revealed a large, healthy population at the main spring (Stevens and Ledbetter 2011).

**Table 27. Verde Rim springsnail distribution and status on the Prescott NF**

HUC 5 Watershed Name	Stream Name	Stream Miles On Forest	Miles of occupied habitat	Historical Presence	Current Presence
Ash Creek and Sycamore Creek	Sycamore Creek	0	0.25	Yes	Yes

## Maricopa tiger beetle

This species is broadly distributed in riparian and moist fine sand habitats across western Utah and most of Arizona at elevations from about 1,100 to 6,900 feet (Stevens and Ledbetter 2011). It is almost wholly confined to moist sandy riparian habitats along perennial streams. Threats include impact of sand and gravel operations, off highway vehicle travel in riparian areas, trampling of burrows by livestock, invasion of stream riparian habitat by noxious and invasive plant species.

Historical and current distribution and status of the Maricopa tiger beetle on the Prescott NF is shown in Table 28. Historically, this species was collected in Walnut Creek, Williamson Valley Wash, Willow Creek, Agua Fria River, and along the Verde River on and adjacent to the forest (McKown 1994). No livestock grazing is authorized along the Verde River on forestlands.

**Table 28. Maricopa tiger beetle distribution and status on the Prescott NF**

HUC 5 Watershed Name	Stream Name	Stream Miles On Forest	Miles of occupied habitat	Historical Presence	Current Presence
Lower Big Chino Wash	Walnut Creek	0.5	Unknown	Yes	Unknown
Williamson Valley Wash	Williamson Valley Wash	Unknown	Unknown	Yes	Unknown
Granite Creek-Upper Verde River	Verde River	4	Unknown	Yes	Unknown
Grindstone Wash-Upper Verde River	Verde River	28	Unknown	Yes	Unknown
Cherry Creek-Upper Verde River	Verde River	3.4	Unknown	Yes	Unknown
Fossil Creek-Lower Verde River	Verde River	15.5	Unknown	Yes	Unknown

## Aquatic Macro-invertebrates

The Prescott NF followed the process and procedures outlined for MIS (Management Indicator Species) selection outlined in the Region 3 Management Indicator Species Selection Process and Criteria (Forest Service 2010). Aquatic macro-invertebrates were chosen as an indicator of water quality based on their responsiveness to changes in water quality and physical features of stream channels essential for quality aquatic habitat. By monitoring aquatic macro-invertebrates populations or/and water quality parameters, the health and productivity of these systems can be assessed.

Aquatic macro-invertebrates include mayflies, stoneflies, caddisflies, blackflies, beetles, midges, freshwater earthworms, snails, and many others. Each species has specific habitat needs and so they respond differently to changes in either the chemical, physical, or biological components of their habitat. These species are classified or separated according to a number of habitat preferences and life history traits. A main distinction between species or groups is their tolerance

to pollution. Species are classified as Pollution Intolerant taxon or Pollution Tolerant taxon. Examples of water quality parameters affecting Pollution Intolerant species are excessive fine sediments, low dissolved oxygen, high water temperatures, and nutrient enrichment.

Aquatic macro-invertebrates are currently a MIS for the current Forest Plan for aquatic habitat and late seral riparian habitat. MIS population and habitat trend data for macro-invertebrates is reported in the Forest Level Analysis of Management Indicator Species for the Prescott NF (Forest Service 2010). Bioassessments and/or water quality assessments have been completed in perennial streams across the forest since 1992 by ADEQ (ADEQ 2000, 2002, 2004, 2008). These assessments are used to evaluate the health of the aquatic community in support of the A&Ww (warmwater aquatic community) designated use classification. The general classification used for surface water quality by ADEQ is Attaining, Impaired, and Inconclusive for the designated uses. Impaired waters on the Forest are primarily for the Verde River. They include nearly all of the Verde River from the Perkinsville Bridge downstream to the boundary with the Tonto National Forest, in four separately listed reaches, due to turbidity. A TMDL (Total Maximum Daily Load) for turbidity has been prepared for the Verde River (ADEQ 2001) with recommendations that when implemented, are predicted to improve the water quality to a status of attaining. Impaired waters also within the forest include reaches of Turkey Creek and Hassayampa Creek. Both impairments are the result of historic mining operations and both have TMDL's in progress and remediation measures initiated. ADEQ has recommended that the turbidity standard be replaced with the suspended sediment concentration (SSC) standard and this proposed standard has been exceeded only during runoff from major storm events. The ADEQ assessments results are summarized in Table 29.

**Table 29. Aquatic macro-invertebrates assessments for streams on the Prescott NF**

<b>Stream Name Segment Waterbody ID and Length</b>	<b>Year Assessed A&amp;Ww Designated Use Support Rating</b>
Verde River Granite Creek to Hell Canyon AZ15060202-052 16-miles	2006 – 2008: Attaining. No exceedances.
Verde River Hell Canyon to 15060202-065 AZ15060202-038 6-miles	2004 – Inconclusive; insufficient sampling events to assess.
Verde River 15060202-065 to Railroad Draw AZ15060202-037 11-miles	2006 –2008: Impaired. A&Ww was assessed as impaired due to turbidity exceedances. No SSC exceedances.
Verde River Sycamore Creek to Oak Creek AZ15060202-025 25.2-miles	2006 –2008: Impaired. A&Ww was assessed as impaired due to turbidity exceedances.
Verde River Oak Creek to Beaver Creek AZ15060202-015 12.2-miles	2006 –2008: Impaired. A&Ww was assessed as impaired due to turbidity exceedances. No SSC exceedances.
Verde River 15060203 to West Clear Creek AZ15060203-027 6.4-miles	2006 –2008: Impaired. A&Ww was assessed as impaired due to turbidity exceedances. No SSC exceedances.

<b>Stream Name Segment Waterbody ID and Length</b>	<b>Year Assessed A&amp;Ww Designated Use Support Rating</b>
Verde River West Clear Creek to Fossil Creek AZ15060203-025 24-miles	2006 –2008: Impaired. A&Ww was assessed as impaired due to turbidity exceedances.
Gap Creek Government Spr. to Verde River. AZ15060203-774B 5.4-miles	2006 –2008: Attaining. No exceedances in turbidity or SSC.
Sycamore Creek Cedar Creek to Verde River. AZ15060202-026 11.7-miles	2006 –2008: Attaining. No exceedances in turbidity or SSC.
Hassayampa River Headwaters to Copper Creek. AZ15070103-007A 11-miles	2006 –2008: Impaired. Exceedances in various standards.
Hassayampa River Copper Creek to Blind Indian Creek. AZ15070103-007B 20-miles	2006 –2008: Attaining. No exceedances.
Little Ash Creek Headwaters to Ash Creek. AZ15070102-039 17.7-miles	2006 –2008: Inconclusive. Insufficient sampling events.
Poland Creek Headwaters to Black Canyon AZ15070102-037	2006 –2008: Not assessed.
Sycamore Creek Tank Canyon to Agua Fria River. AZ15070102-024 17.6-miles	2006 –2008: Attaining. No exceedances.
Turkey Creek Headwaters to Poland Creek. AZ15070102-036 9.1-miles	2006 –2008: Attaining. No exceedances.

## Identification of Species Groups

The species carried forward for analyses in this process are assigned to the Aquatic and Terrestrial Vegetation Categories used for Ecosystem Diversity Analysis (FSH 1909.12, Chap 40, Sec. 43.12). All aquatic species and the MIS macro-invertebrates, except for the Maricopa tiger beetle, are assigned to the Aquatic category. The Maricopa tiger beetle is assigned to the Terrestrial Vegetation category. Ecosystem diversity for the Aquatic Category is addressed at the HUC 5 (Hydrological Unit Code) Watershed scale (see Water Resources Report). Ecosystem diversity for the Terrestrial Vegetation Category is addressed at the PNVT (Potential Natural Vegetation Type) scale (see Vegetation Diversity Report).

## Summary of Alternatives

A total of four alternatives are described in the DEIS. A summary of each alternative is described below.

## **Alternative A – 1987 Forest Plan Direction**

Alternative A would continue management under the existing plan for the Prescott National Forest. The plan provides for timber production, fuelwood harvest, hazardous fuel reduction treatments, prescribed fire and management of unplanned ignitions to meet resource objectives.

Under Alternative A, thinning to alter or restore vegetation structure and composition occurs on about 550 acres per year in ponderosa pine and on 300 acres per year in piñon-juniper vegetation. Fire managers treat about 7,835 acres per year using prescribed fire across all vegetation types.

Plan Direction/Goals for Wildlife and Fish Habitat are in place to

- 1) Manage for a diverse, well distributed pattern of habitats for wildlife populations and fish species in cooperation with states and other agencies;
- 2) Maintain and/or improve habitat for threatened or endangered species and work toward the eventual recovery and delisting of species through recovery plan implementation; and
- 3) Integrate wildlife habitat management activities into all resource practices through intensive coordination.

## **Alternative B – The Proposed Revised Plan**

Alternative B places an emphasis on restoring vegetation, structure, composition, and desired characteristics of fire to five ecosystems that are moderately or highly-departed from desired conditions. It also addresses citizen concerns related to smoke emissions and responds to the anticipated effects of climate change.

Alternative B would increase the amount of thinning and prescribed fire occurring across the landscape. Planned ignitions would range from 10,600 to 25,300 acres per year on average. Thinning treatments would range from 1,750 to 6,500 acres per year on average. Additionally, wildland urban interface (WUI) areas would be given high priority for fuel reduction treatments, using mechanical methods and/or domestic animals in lieu of planned ignitions.

Watershed Integrity Management includes several objectives (O-18 to 23) to improve watershed, riparian, stream crossings, and springs/seeps sites across the forest.

Aquatic Habitat Management includes an objective (O-24) to restore native fish species in 2-3 stream reaches across the forest.

Eight potential wilderness areas are recommended at a total of 43,440 acres. Recommended areas include Apache Creek A, Apache Creek B, Bald Mountain, Black Canyon, Castle Creek Contiguous, Juniper Mesa, Sycamore Canyon A, and Sycamore Canyon C. All areas are already identified roadless areas.

## **Alternative C – Vegetation and Wildlife Habitat Emphasis**

Alternative C includes many of the same components of Alternative B, however, it responds to public comments to increase emphasis on vegetation trends within both grassland and ponderosa pine types. This focus improves vegetation conditions within important wildlife habitats and places less emphasis on some vegetation communities and recreational components. In addition, Alternative C includes more management treatment for native fish and other aquatic species and pronghorn habitats; there is much less emphasis on recommendation of potential wilderness areas.

Alternative C would emphasize a higher range of prescribed fire and a lower range of thinning activity compared to Alternatives A and B. Planned ignitions would range from 15,500 to 22,800 acres per year on average and would be focused in grassland and ponderosa pine vegetation. Thinning treatments would range from 1,750 to 4,000 acres per year on average.

Watershed Integrity Management includes several objectives (O-18 to 23) to improve watershed, riparian, stream crossings, and springs/seeps sites across the forest. Same as Alternative B.

Aquatic Habitat Management includes an objective (O-24) to restore native fish species in 4-6 stream reaches across the forest.

Emphasis on improving vegetation and wildlife desired conditions involves more management activities such as prescribed fire, mechanical removal of vegetation, or stream restoration over more areas of the forest in order to provide for an increased rate of change toward desired conditions. Therefore, no wilderness areas are recommended in this alternative.

## **Alternative D – Dispersed Recreation Emphasis**

Alternative D includes an emphasis on providing increased dispersed recreation opportunities. Within recreational opportunities, there would be reduced emphasis on developed recreation, such as campgrounds, and increased emphasis on dispersed recreation such as adding trails, improving trailheads and adding designated dispersed sites.

Alternative D would emphasize less prescribed fire than Alternatives B and C, and similar or less thinning activity. Planned ignitions would range from 10,600 to 18,800 acres per year on average. Thinning treatments would range from 1,750 to 4,000 acres per year on average (the same as Alternative C).

Watershed Integrity Management includes several objectives (O-18 to 23) to improve watershed, riparian, stream crossings, and springs/seeps sites across the forest. Same as Alternative B.

Aquatic Habitat Management includes an objective (O-24) to restore native fish species in 2-3 stream reaches across the forest. Same as Alternative B.

This alternative includes recommendation of the highest number of potential wilderness areas at 16 areas totaling 116,262 acres. Additional areas to Alternative B include Arnold Mesa, Ash Creek, Cedar Bench A, Cedar Bench B, Fritsche B, Muldoon, Pine Mountain B, Pine Mountain C, Sycamore Canyon B, and Woodchute. All areas are already identified roadless areas.

## Methodology and Analysis Process

Plan decisions in the current forest plan and the alternatives to be evaluated include goals/desired conditions, objectives, standards/guidelines, suitability of uses, special areas, and monitoring. The management actions to be considered in this evaluation include the objectives identified to meet the need for change on the forest. These include the use of prescribed fire and mechanical treatments to restore vegetation and natural fire regimes to the ecosystem, projects to maintain or improve watershed integrity, projects to maintain and provide for recreational experiences, projects to maintain or improve aquatic and wildlife habitat, and opportunities to enhance the scenic value. A concurrent decision in the forest revision process included in this evaluation is the designation of wilderness areas.

The evaluation of effects on species viability of the LRMP alternatives is based on the effects to the ecological conditions that provide for ecosystem diversity (FSH 1909.12, Chap. 40, and Sec. 43.21). The overall assumption of ecosystem management is that managing systems within the range of conditions that native species have experienced over evolutionary time is likely to maintain populations of those species. The evaluation of effects will be assessed as a risk to species viability from the LRMP alternatives. Risk is comprised of two components: the likelihood of a negative outcome and the severity of a negative outcome. From an ecological standpoint, a negative outcome is defined as a departure from reference conditions.

The following indicators were considered for each species in this analysis:

1. How habitat quantity, quality, and distribution is affected by management actions.
2. The trends in the quantity, quality, and distribution of habitat;
3. The trends in distribution and abundance of the species;

The effects from management actions to the indicators are influenced by numerous measures such as the extent of area affected, the severity of impacts, and the duration of impacts. The consequences of the impacts are then related to their effect on trends to the aquatic ecosystem and species populations. The ratings and their descriptions are as follows:

### Low

Management actions would have low likelihood of changing habitat quantity or distribution in the planning area. Management Actions could have low to high levels of ground or vegetation disturbance in the watersheds. However, due but due to small area of impacts and with implementation of BMPs (Best Management Practices<sup>9</sup>) there would be minimal impacts to habitat quality in aquatic ecosystems. Trends to aquatic ecosystem and species populations would be maintained or improved in the planning area.

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<sup>9</sup> Best Management Practices (BMPs) are a practice or combination of practices determined to be the most effective, practicable means of preventing or reducing the amount of pollution generated by nonpoint sources to a level compatible with water quality goals, and are developed to comply with the Clean Water Act.

## **Moderate**

Management actions would have low likelihood of changing habitat quantity or distribution in the planning area. Management Actions could have low to high levels of ground or vegetation disturbance in the watershed with larger extent of area impacted. There would be impacts to habitat quality from sedimentation and higher peakflows due to extent and severity of impacts even with implementation of BMPs. However, impacts would be of short duration and would maintain or improve habitat quality in the long term. Trends to aquatic ecosystem and species populations would be maintained or improved in the planning area.

## **High**

Management actions would have moderate to high likelihood of decreasing habitat quantity or distribution in the planning area. Management actions would have high extent, severity, and duration of impacts to the aquatic ecosystem. There would be adverse impacts to aquatic habitat quantity, quality, and distribution even with implementation of BMPs. The decrease in habitat would reduce species populations in the planning area.

In this analysis, the following assumptions have been made:

- The land management plan provides a programmatic framework for future site-specific actions.
- Land management plans do not have direct effects. They do not authorize or mandate any site-specific projects or activities (including ground-disturbing actions).
- Land management plans may have implications, or environmental consequences, of managing the forests under a programmatic framework.
- Law, policy, and regulations will be followed when planning or implementing site-specific projects and activities.
- The plan decisions (desired conditions, objectives, standards, guidelines, management areas, monitoring) will be followed when planning or implementing site-specific projects and activities.
- Monitoring will occur and the land management plan will be amended, as needed.
- Management activities that help ecosystems accommodate changes adaptively will improve ecosystem resiliency in the long-term.
- The planning timeframe is 10 years; other timeframes may be analyzed to compare anticipated trends into the future.

## **Environmental Consequences**

The land management plan provides a programmatic framework that guides site-specific actions but does not authorize, fund, or carry out any project or activity. Because the land management plan does not authorize or mandate any ground-disturbing actions, there are no direct effects. However, there may be implications, or longer term environmental consequences, of management on the Prescott NF under this programmatic framework.

The summary of environmental consequences from management actions to trends of aquatic ecosystem diversity and species diversity by Alternatives is shown in Table 30. All Alternatives would contribute towards maintaining trends in aquatic ecosystem diversity with Alternative A having the least improvement of current conditions. Alternative B-D are all similar in their environmental consequences and would have greater improvement of aquatic habitat quality due to more emphasis in restoration of natural fire regimes and the reduction in potential for high severity fire in the planning area, and projects to improve watershed (vegetation and soil), riparian, and aquatic conditions. Alternative A would maintain current conditions of species diversity in the planning area that are highly departed from reference conditions due to presence of non-native aquatic species. Alternative B-D would improve species diversity through native fish restoration with Alternative C having the highest level of improvement in the planning area.

**Table 30. Summary of consequences by alternative**

Management Action/Indicator Measurements	Alternatives			
	A	B	C	D
<b>Vegetation Treatments with Fire</b>				
Management Effects to habitat quantity, quality, and distribution	M	M	M	M
Trends in habitat quantity, quality, and distribution	S	S	S	S
Trends in species distribution and abundance	S	S	S	S
<b>Vegetation Treatments with Mechanical</b>				
Management Effects to habitat quantity, quality, and distribution	M	M	M	M
Trends in habitat quantity, quality, and distribution	S	S	S	S
Trends in species distribution and abundance	S	S	S	S
<b>Non-native invasive plant species management</b>				
Management Effects to habitat quantity, quality, and distribution	L	L	L	L
Trends in habitat quantity, quality, and distribution	S	S	S	S
Trends in species distribution and abundance	S	S	S	S
<b>Recreation Management Actions</b>				
Management Effects to habitat quantity, quality, and distribution	L	L	L	L
Trends in habitat quantity, quality, and distribution	S	S	S	S
Trends in species distribution and abundance	S	S	S	S
<b>Watershed Management Actions</b>				
Management Effects to habitat quantity, quality, and distribution	L	L	L	L
Trends in habitat quantity, quality, and distribution	I	I	I	I
Trends in species distribution and abundance	S	S	S	S
<b>Aquatic Habitat Management Actions</b>				
Management Effects to habitat quantity, quality, and distribution	L	L	L	L
Trends in habitat quantity, quality, and distribution	I	I	I	I
Trends in species distribution and abundance	I	I	I	I
<b>Terrestrial Wildlife Habitat Management Actions</b>				
Management Effects to habitat quantity, quality, and distribution	L/M	L/M	L/M	L/M
Trends in habitat quantity, quality, and distribution	S	S	S	S
Trends in species distribution and abundance	S	S	S	S

Management Action/Indicator Measurements	Alternatives			
	A	B	C	D
<b>Land Acquisition Management Actions</b>				
Management Effects to habitat quantity, quality, and distribution	L	L	L	L
Trends in habitat quantity, quality, and distribution	S	S	S	S
Trends in species distribution and abundance	S	S	S	S
<b>Designated Wilderness Areas</b>				
Management Effects to habitat quantity, quality, and distribution	L	L	L	L
Trends in habitat quantity, quality, and distribution	S	S	S	S
Trends in species distribution and abundance	S	S	S	S

Key to Indicator effects:

Management Effects: L (Low); M (Moderate); and H (High)

Trend to Habitat elements: S (Stable); I (Increase); D (Decrease)

Trend to Species population: S (Stable); I (Increase); D (Decrease)

## Management Effects common to all Alternatives

Management actions to treat vegetation using fire, timber harvest, and mechanical treatments would occur across the landscape of the forest within the 10-year planning period. Fire use is intended to result in low intensity and low severity fire in most vegetation types though it usually is higher in chaparral which is characteristic for this type. The effects of fire on aquatic ecosystems depend on factors such as the extent of burned area, severity of the fire, soils/geology/topography, development of soil repellency, and post-fire storm events and climate. As a general rule, the potential for negative effects to aquatic species and their habitat increases as the percentage of the watershed affected by management actions increases. All treatments would result in disturbances to the watershed with increases in runoff, erosion, sediment yields, and water yields that could impact aquatic habitat quality. All projects would follow Forest Plan management direction to minimize impacts to aquatic ecosystems and would retain habitat quantity and distribution in the planning area. These treatments are intended to restore the natural fire regime, improve forest health, and reduce the potential for high severity wildfire in the planning area. These treatments would result in improved watershed, soil, and vegetation conditions in the planning area. These management actions would have long-term benefits to maintaining or improving aquatic habitats and maintaining species populations on the forest.

Management actions to improve watershed integrity would occur across the landscape on the forest within the 10-year planning period. Watershed and riparian improvement projects would move soil and vegetation conditions toward satisfactory conditions. Road and motorized trail maintenance would repair or maintain these features to the appropriate level of maintenance and provide for runoff and sedimentation dispersal along the routes and reduce sedimentation to drainages. Closure and/or obliteration of unauthorized routes on the forest would improve watershed conditions as the affected areas are allowed to revegetate which would decrease runoff and erosion off the routes. Improvement of stream or drainage crossings would reduce impacts to aquatic habitats from sedimentation. Restoration of groundwater dependent ecosystem sites

would improve conditions for aquatic species and their habitats. All projects would follow Forest Plan management direction to minimize impacts to aquatic ecosystems. These management actions would have long-term benefits to maintaining or improving aquatic habitats and maintaining species populations on the forest.

Management actions to operate and maintain developed recreational facilities such as campgrounds, day use/picnic areas, designated dispersed sites, trailheads and trails would occur across the forest. Current recreational facilities and future developments would tend to concentrate and increase human use. Recreational facilities near aquatic habitats could impact riparian vegetation, streambanks, and water quality. All projects would follow Forest Plan management direction to minimize impacts to aquatic ecosystems and would retain habitat quantity and distribution in the planning area.

Management actions to improve aquatic and wildlife habitat would occur across the landscape on the forest within the 10-year planning period. Projects would restore species habitat through various actions such as prescribed fire, mechanical vegetation treatments, invasive plant species treatments, and invasive aquatic species control. All projects would follow Forest Plan management direction to minimize impacts to aquatic ecosystems and would retain habitat quantity and distribution in the planning area. Native fish restoration would have long-term benefits to maintaining or improving aquatic habitats and maintaining species populations on the forest.

Open space and Land adjustment management actions would acquire lands with important values to the forest. Opportunities to acquire lands near the Verde River and other stream systems with high aquatic ecosystem and native species values would increase management actions to protect and improve these areas. This would have long term benefits to maintaining or improving aquatic species and their habitats in the planning area.

Wilderness Management would occur across the landscape on the forest within the 10-year planning period. These areas would be managed to maintain natural processes, ecosystems, and native species. Forest Plan management direction would be followed to minimize impacts to aquatic ecosystems and would retain habitat quantity and distribution in the planning area.

### **Alternative A (No action)**

Under current management, vegetation treatments using fire, timber harvest, and mechanical treatments would occur on about 9% of the forest within the 10 year planning period. This level of activities would have the least improvement to watershed conditions and to the aquatic ecosystem. The threat of wildfire would be maintained at a higher level than the Action Alternatives. Overall, trends in aquatic habitat quantity, quality, and distribution would remain stable across the forest in relation to forest management actions. Alternative A would maintain current conditions and trends of species diversity in the planning area that are highly departed from reference conditions due to presence of non-native aquatic species. This alternative would have the least change in species trends on the forest mainly from the low emphasis on native fish restoration.

## **Alternative B (Proposed Revised Forest Plan)**

Under this alternative, there would be an increase over the current forest plan in fire use, mechanical treatments, and timber harvest. A total of 9 to 25% of various vegetation types across the forest would be treated within the 10-year planning period. The increase in area treated would improve watershed, vegetation, and soils conditions, restore fire regimes, and reduce the potential for wildfire at a higher rate than Alternative A. The increase in management actions for watershed integrity would improve watershed, vegetation, soil, riparian, and aquatic conditions at a higher rate than Alternative A. The addition of the eight potential wilderness areas would restrict active management actions such as mechanical equipment use to implement watershed, soil, riparian, vegetation, and native fish improvement projects in these areas. The potential wilderness areas that could limit management actions to improve trends to aquatic species and their habitat would be the Sycamore Canyon A area along the Verde River. Native fish restoration in 2- 3 stream reaches on the forest would increase species distribution and abundance. Management direction to acquire land near the Verde River and other stream systems would increase management actions to protect and improve these areas. Other management actions related to recreation and wilderness would have minimal environmental consequences to aquatic species or their habitats.

Overall, forest wide trends in aquatic habitat quantity and distribution would be maintained at current/historical levels except with the acquisition of any lands with species and habitat in which case it would increase. Trends in habitat quality would improve in relation to water quality factors (e.g. sedimentation) under various management actions. Trends in species distribution and abundance would increase in the planning area.

## **Alternative C (Vegetation & Wildlife Emphasis)**

Environmental consequences under this alternative would be similar to Alternative B in relation to management actions in the Vegetation, Watershed Integrity, Open Space plan components. The amount of area to be treated under the Vegetation objectives is 13 to 21% of the forest within the 10-year plan timeframe. It would also be similar for Recreation except that no additional potential wilderness areas would be recommended. Management actions to improve 4-6 stream reaches for native fish species are the highest of all alternatives.

Overall, forest wide trends in aquatic habitat quantity and distribution would be maintained at current/historical levels except with the acquisition of any lands with species and habitat in which case it would increase. Trends in habitat quality would improve in relation to water quality factors (e.g. sedimentation) under various management actions. Trends in species distribution and abundance would increase in the planning area that highest of all alternatives.

## **Alternative D (Dispersed Recreation Alternative)**

Environmental consequences under this alternative would be similar to Alternative B in relation to management actions in the Vegetation, Watershed Integrity, Open Space plan components. The amount of area to be treated under the Vegetation objectives is 9 to 18% of the forest within the 10-year plan timeframe. Recreation plan components for additional potential wilderness areas are the highest of all alternatives with 16 areas and a total of 116,260 acres. The addition of these

potential wilderness areas would restrict active management actions such as mechanical equipment use to implement watershed, soil, riparian, and vegetation in these areas. The potential wilderness areas that would limit management actions to improve trends to aquatic species and their habitat would be the Muldoon and Sycamore Canyon A and B along the Verde River and Pine Mountain B and C near Sycamore Creek (Pine Mountain Wilderness).

Overall, trends to aquatic habitat and species abundance/distribution would be similar to Alternative B.

## **Species Effects Analysis**

This effects analysis includes the 18 species of fish, amphibians, reptiles, and invertebrates that were of viability concern within the planning area and aquatic macro-invertebrates which were chosen as a Management Indicator Species for aquatic ecosystems.

## **Federally Listed Species and Designated Critical Habitat**

### **Gila chub & designated Critical habitat**

#### **Alternative A**

This alternative would have the least change to trends in aquatic habitat and Gila chub populations on the forest mainly from the low emphasis on native fish restoration. Gila chub populations would be maintained at current levels which are departed from historical conditions due to presence of invasive aquatic species. Environmental consequences from management actions would be low to moderate to Gila chub and their designated critical habitat in the Ash Creek/Sycamore Creek 5<sup>th</sup> HUC watershed on the forest. Management actions would not change habitat quantity and distribution. Managed fire in these watersheds would have the greatest potential to affect water quality in the short term from runoff and sedimentation but in the long term would improve water quality as watershed conditions are improved. Fire management would also reduce the potential for catastrophic wildfire in these watersheds. All other management actions would maintain or improve habitat quality. This alternative would maintain species viability on the forest but would not increase trends in species populations.

#### **Alternatives B & D**

These alternatives would increase trends in aquatic habitat and Gila chub populations on the forest mainly from native fish restoration actions, watershed integrity projects, and possibly from land acquisition of inholdings along occupied and critical habitat. The alternatives would be equal in meeting desired conditions for Gila chub in the Ash Creek/Sycamore Creek 5<sup>th</sup> HUC watershed. Environmental consequences of the other management actions would be similar to Alternative A. These alternatives would maintain species viability on the forest and would increase trends in species populations.

## **Alternative C**

The consequences for Alternative C are very similar to those for Alternatives B and D. However, Alternative C has a higher level of habitat restoration and thus would promote the greatest increase in Gila chub habitat and population on the forest.

### **Determination of Effect for Gila chub**

Common to all Alternatives: The implementation of plan components related to vegetation treatments, recreation management, watershed management, Wildlife/Fish/Rare Plant management, and Land Acquisition management may have short term indirect effects to aquatic habitat and species populations but would result in long term benefits to maintaining or improving aquatic habitat and species populations on the forest. Implementation would result in a “May Affect, Not likely to adversely affect” the Gila chub.

### **Determination of Effect for Gila chub Critical Habitat**

Common to all Alternatives: The implementation of plan components related to vegetation treatments, recreation management, watershed management, Wildlife/Fish/Rare Plant management, and Land Acquisition management may have short term indirect effects to elements of critical habitat but would result in long term benefits to maintaining or improving critical habitat on the forest. Implementation would result in a “May Affect, Not likely to adversely affect” critical habitat for the Gila chub.

## **Gila topminnow**

### **Alternative A**

This alternative would have the least change to trends in aquatic habitat and Gila topminnow populations on the forest mainly from the low emphasis on native fish restoration. There would be low potential for reintroduction of Gila topminnow populations due to presence of invasive aquatic species in aquatic habitats. The highest potential for reintroductions are in the Ash Creek/Sycamore Creek and Hassayampa River 5th HUC watersheds. Environmental consequences of other management actions would be similar to Gila chub. Species viability would not be achieved on the forest without restoration of aquatic habitats that would allow for reintroductions of populations.

### **Alternatives B & D**

These alternatives would increase trends in aquatic habitat and Gila topminnow populations on the forest mainly from native fish restoration actions, watershed integrity projects, and possibly from land acquisition of inholdings with water rights along perennial or perennial interrupted streams in the Upper Verde River, Hassayampa River, and Agua Fria River sub-basins. The alternatives would be equal in meeting desired conditions for Gila topminnow in the Ash Creek/Sycamore Creek and Hassayampa 5th HUC watersheds. Environmental consequences of

the other management actions would be similar to Alternative A. These alternatives would maintain species viability on the forest and would increase trends in species populations.

### **Alternative C**

The consequences for Alternative C are very similar to those for Alternatives B and D. However, Alternative C has a higher level of habitat restoration and thus would promote the greatest increase in Gila topminnow habitat and population on the forest.

### **Determination of Effect for Gila topminnow**

Common to all Alternatives: The implementation of plan components related to vegetation treatments, recreation management, watershed management, Wildlife/Fish/Rare Plant management, and Land Acquisition management may have short term indirect effects to aquatic habitat and species populations but would result in long term benefits to maintaining or improving aquatic habitat and species populations on the forest. Implementation would result in a “May Affect, Not likely to adversely affect” the Gila topminnow.

### **Razorback sucker/designated Critical habitat & Colorado pikeminnow**

#### **Alternative A**

This alternative would have the least change to trends in aquatic habitat and populations of razorback sucker and Colorado pikeminnow on the forest mainly from the low emphasis on native fish restoration. Populations of these species would be maintained at current levels in the Verde River which is departed from historical conditions due to presence of invasive aquatic species and existing dams on the river (off the forest). Management actions would not change habitat quantity and distribution. Managed fire in these watersheds would have the greatest potential to affect water quality in the short term from runoff and sedimentation but in the long term would improve water quality as watershed conditions are improved. Fire management would also reduce the potential for catastrophic wildfire in these watersheds. All other management actions would maintain or improve habitat quality. Species viability would not be achieved on the forest without restoration of aquatic habitats that would allow for establishment of introduced populations.

#### **Alternatives B & D**

These alternatives would increase trends in aquatic habitat and populations of razorback sucker and Colorado pikeminnow on the forest mainly from native fish restoration actions, watershed integrity projects, and possibly from land acquisition of inholdings with water rights along occupied and critical habitat. The alternatives would be equal in meeting desired conditions for these species in the Verde River. Environmental consequences of the other management actions would be similar to Alternative A. These alternatives would maintain species viability on the forest and would increase trends in species populations.

## **Alternative C**

The consequences for Alternative C are very similar to those for Alternatives B and D. However, Alternative C has a higher level of habitat restoration and thus would promote the greatest increase in Razorback sucker and Colorado pikeminnow habitat and populations on the forest.

### **Determination of Effect for Razorback sucker and Colorado pikeminnow**

Common to all Alternatives: The implementation of plan components related to vegetation treatments, recreation management, watershed management, Wildlife/Fish/Rare Plant management, and Land Acquisition management may have short term indirect effects to aquatic habitat and species populations but would result in long term benefits to maintaining or improving aquatic habitat and species populations on the forest. Implementation would result in a “May Affect, Not likely to adversely affect” the Razorback sucker and “Not likely to jeopardize” the Experimental Nonessential population of Colorado pikeminnow.

### **Determination of Effect for Razorback sucker Critical Habitat**

Common to all Alternatives: The implementation of plan components related to vegetation treatments, recreation management, watershed management, Wildlife/Fish/Rare Plant management, and Land Acquisition management may have short term indirect effects to elements of critical habitat but would result in long term benefits to maintaining or improving critical habitat forest. Implementation would result in a “May Affect, Not likely to adversely affect” critical habitat for the Razorback sucker.

### **Spikedace, Loach minnow & designated Critical habitat**

#### **Alternatives A, B, C, & D**

Same environmental consequences as for razorback sucker and Colorado pikeminnow and critical habitat.

### **Determination of Effect for Spikedace and Loach minnow**

Common to all Alternatives: The implementation of plan components related to vegetation treatments, recreation management, watershed management, Wildlife/Fish/Rare Plant management, and Land Acquisition management may have short term indirect effects to aquatic habitat and species populations but would result in long term benefits to maintaining or improving aquatic habitat and species populations on the forest. Implementation would result in a “May Affect, Not likely to adversely affect” the Spikedace and Loach minnow.

### **Determination of Effect for Spikedace and Loach minnow designated Critical Habitat**

Common to all Alternatives: The implementation of plan components related to vegetation treatments, recreation management, watershed management, Wildlife/Fish/Rare Plant

management, and Land Acquisition management may have short term indirect effects to elements of critical habitat but would result in long term benefits to maintaining or improving critical habitat forest. Implementation would result in a “Not likely to adversely modify” designated critical habitat for the Spikedace and Loach minnow.

## **Gila trout**

### **Alternative A**

This alternative would have the least change to trends in aquatic habitat and Gila trout populations on the forest mainly from the low emphasis on native fish restoration. Gila trout populations would be maintained at current levels which are above historical conditions due to introduction in the Big Bug Creek 5th HUC watershed. Management actions would not change habitat quantity and distribution. All other management actions would maintain or improve habitat quality. This alternative would maintain species viability on the forest but would not increase trends in species populations.

### **Alternatives B & D**

These alternatives would increase trends in aquatic habitat and Gila trout populations on the forest mainly from native fish restoration actions, watershed integrity projects, and possibly from land acquisition of inholdings with water rights along suitable habitat. The alternatives would be equal in meeting desired conditions for Gila trout in the Big Bug 5th HUC watershed. Environmental consequences of the other management actions would be similar to Alternative A. These alternatives would maintain species viability on the forest and would increase trends in species populations.

### **Alternative C**

The consequences for Alternative C are very similar to those for Alternatives B and D. However, Alternative C has a higher level of habitat restoration and thus would promote the greatest increase in Gila trout habitat and population on the forest.

### **Determination of Effect for Gila trout**

Common to all Alternatives: The implementation of plan components related to vegetation treatments, recreation management, watershed management, Wildlife/Fish/Rare Plant management, and Land Acquisition management may have short term indirect effects to aquatic habitat and species populations but would result in long term benefits to maintaining or improving aquatic habitat and species populations on the forest. Implementation would result in a “May Affect, Not likely to adversely affect” the Gila trout.

## **Candidate Species**

### **Roundtail chub**

#### **Alternatives A, B, C, & D**

Same environmental consequences as for Razorback sucker and Colorado pikeminnow.

#### **Determination of Effect for Roundtail chub**

Common to all Alternatives: The implementation of plan components related to vegetation treatments, recreation management, watershed management, Wildlife/Fish/Rare Plant management, and Land Acquisition management may have short term indirect effects to aquatic habitat and species populations but would result in long term benefits to maintaining or improving aquatic habitat and species populations on the forest. Implementation would result in a “May impact individuals of Roundtail chub, but it not likely to result in a trend toward federal listing or loss of viability”.

### **Northern Mexican gartersnake**

#### **Alternatives A, B, C, & D**

Same environmental consequences as for Razorback sucker and Colorado pikeminnow.

#### **Determination of Effect for Northern Mexican gartersnake**

Common to all Alternatives: The implementation of plan components related to vegetation treatments, recreation management, watershed management, Wildlife/Fish/Rare Plant management, and Land Acquisition management may have short term indirect effects to aquatic habitat and species populations but would result in long term benefits to maintaining or improving aquatic habitat and species populations on the forest. Implementation would result in a “May impact individuals of Mexican gartersnake, but it not likely to result in a trend toward federal listing or loss of viability”.

## **Sensitive Species**

### **Alternative A**

This alternative would have the least change to trends in aquatic habitat and populations of Sensitive species on the forest mainly from the low emphasis on native fish restoration. Populations of these species would be maintained at current levels in the Verde River and small streams which are departed from historical conditions due to presence of invasive aquatic species. Management actions would not change habitat quantity and distribution. Managed fire in these watersheds would have the greatest potential to affect water quality in the short term from runoff

and sedimentation but in the long term would improve water quality as watershed conditions are improved. Fire management would also reduce the potential for catastrophic wildfire in these watersheds. All other management actions would maintain or improve habitat quality. This alternative would maintain species viability for all Sensitive species on the forest but would not increase trends in species populations.

### **Alternatives B & D**

These alternatives would increase trends in aquatic habitat and Sensitive species populations on the forest mainly from native fish restoration actions, watershed integrity projects, and possibly from land acquisition of inholdings with suitable or occupied habitat. The alternatives would be equal in meeting desired conditions for Sensitive species. Environmental consequences of the other management actions would be similar to Alternative A. These alternatives would maintain species viability on the forest and would increase trends in species populations.

### **Alternative C**

The consequences for Alternative C are very similar to those for Alternatives B and D. However, Alternative C has a higher level of habitat restoration and thus would promote the greatest increase in Sensitive species habitat and populations on the forest.

#### **Determination of Effect for Sensitive Species**

Common to all Alternatives: The implementation of plan components related to vegetation treatments, recreation management, watershed management, Wildlife/Fish/Rare Plant management, and Land Acquisition management may have short term indirect effects to aquatic habitat and species populations but would result in long term benefits to maintaining or improving aquatic habitat and species populations on the forest. Implementation would result in a “May impact individuals of Sensitive species, but it not likely to result in a trend toward federal listing or loss of viability”.

### **Other species Analyzed**

#### **Speckled dace and Maricopa tiger beetle**

##### **Alternatives A, B, C, & D**

Same environmental consequences as for Sensitive species.

### **Management Indicator Species**

#### **Alternative A**

This alternative would have the least change to trends in MIS habitat and populations for macro-invertebrates on the forest due to having the lowest level of forestland restoration. Populations of

these species would be maintained at current levels in the Verde River and small streams which are departed from historical conditions due to mining impacts and impaired watershed conditions. Management actions would not change habitat quantity and distribution. Managed fire in watersheds would have the greatest potential to affect water quality in the short term from runoff and sedimentation but in the long term would improve water quality as watershed conditions are improved. Fire management would also reduce the potential for catastrophic wildfire in these watersheds. All other management actions would maintain or improve habitat quality. This alternative would maintain current forest-wide trends for macro-invertebrate habitat and populations.

### **Alternatives B, C, D**

All these alternatives would increase trends in MIS habitat and populations for macro-invertebrates on the forest mainly due to higher levels of forestland restoration efforts. All alternatives would be equal in meeting desired conditions for macro-invertebrates. Environmental consequences of the other management actions would be similar to Alternative A. These alternatives would maintain or improve forest-wide trends for macro-invertebrate habitat and populations.

## **Relationship of Short-Term Impacts and Long-Term Benefits**

A factor to be considered in this analysis is the short-term impacts to aquatic species and their habitats from management actions and the long-term benefit to the ecological conditions to support viable populations of these species in the planning area. The following applies to all alternatives.

Forest management actions that have high disturbance levels to vegetation and soils such as fire use, timber harvest, and roads have the greatest potential to impact aquatic species and their habitats. In general, the larger the area impacted, the higher is the potential for negative effects. Under all alternatives, the use of fire to meet resource objectives and desired conditions would result in low intensity/severity fire and less impacts to watershed, soil, and aquatic systems. An exception to this is fire use in chaparral which tends to result in higher intensity burns which is characteristic for this vegetation type. In most cases, vegetative ground cover in all treated areas is expected to recover quickly (1 to 3 years) and reestablish surface runoff/water yield and sedimentation levels to pre-fire conditions. In the long term, treatments are expected to restore the historic fire regime in the vegetation types, improve watershed conditions, and reduce the potential for large, wildfire events.

The other management actions such as recreational developments and activities would have less short-term impacts to aquatic ecosystems because of their smaller areas of impacts across the forest.

## **Cumulative Environmental Consequences**

The cumulative consequences analysis area includes the eight HUC 4 sub-basins that encompass the forest planning area. The area extents of these sub-basins are given in Table 31. Because the Prescott NF covers only 1 – 4 % (12,000 – 19,000 acres, respectively) of the Big Sandy River and

Burro Creek sub-basins and there are no perennial streams on the forest it is being dropped from further consideration to cumulative effects.

**Table 31. Sub-basin extent and perennial stream miles**

HUC 4 Sub-basin Name	Area in Square miles			Perennial Stream Miles		
	Sub-basin	PNF	PNF as % of Sub- basin	Sub-basin	PNF	PNF as % of Sub- basin
Big Sandy River	2154	18	0.9	86	0	0%
Burro Creek	713	29	4.1	27	0	0%
Santa Maria River	1433	227	15.8	41	1	3%
Big Chino Wash	2153	344	16.0	12	1	5%
Upper Verde	2507	553	22.1	187	37	20%
Lower Verde	1965	65	3.3	297	18	6%
Agua Fria River	2785	531	19.1	57	9	16%
Hassayampa River	1454	195	13.4	32	13	42%
<b>Totals</b>	<b>15,165</b>	<b>1,962</b>		<b>739</b>	<b>79</b>	

Population growth in the area surrounding the forest is expected to continue (see Table 5). Residential home and commercial development would continue in the watersheds on private lands and have various impacts to watershed integrity. Impacts would be greatest in those sub-basins with higher amount of private land ownership such as Big Chino Wash and Upper Verde River. Demand for outdoor recreation is also expected to grow concurrently with increasing population with more visitor use of the forest.

Off-forest water uses are having some effect to streamflows on the forest, especially to the Verde River (Table 6), and are expected to have a greater impact with increasing population and groundwater demands in watersheds that cover the forest. Impacts would be greatest in those sub-basins with higher amount of private land ownership such as Big Chino Wash and Upper Verde River. Currently, the City of Prescott has a water right of 2,700 acre feet per year from Del Rio Springs, near the headwaters of the Verde River. In addition, the Arizona Groundwater Transportation Act (A.R.S. 45-555), contains an exemption for the city of Prescott allowing them to transfer between 8,000 and 14,000 acre-feet per year from the Big Chino aquifer. The city of Prescott has purchased land in the Big Chino basin and is in the planning stages of construction of a pipeline for water transfer to the city. The city has also purchased lands with water rights in the area with the intent of retiring about 3,600 acre-feet per year of water as potential mitigation for the water transfer. Potential impacts from groundwater withdrawals in the Big Chino aquifer include reduction in river flow levels in the upper Verde River.

Other land uses such as livestock grazing, mining, and vegetation treatments is occurring across the watersheds on federal, state, private, and tribal lands. Management actions on federal and state lands follow law, policy, and other management direction to minimize impacts to aquatic

ecosystems. Actions on private lands completed with federal or state dollars are also required to complete environmental assessment on impacts to species and their habitats.

Looking forward, there is general agreement among climate modelers that by the end of the 21st century, the Southwest is likely to experience the following conditions from climate change (Forest Service, 2010):

- Temperature increases of five to eight degrees Fahrenheit (or about 0.5°F/decade on average)
- An increase in the number of hot days, with summer heat waves lasting two weeks or longer
- Warmer winters and reduced snowpack, and a later monsoonal season
- A five percent drop in precipitation in most of Arizona and New Mexico
- An increase in extreme flood events following an overall increase in tropical storms

The current plan does not recognize the potential impacts from climate change. Guidance for addressing this issue is contained in *Navigating the Climate Change Performance Scorecard* (Forest Service 2011b) and would need to be integrated into the current plan. The extent of this effort is unknown, but would involve an amendment to the monitoring section of the plan. The result would be that increased effort would be needed to adapt management practices to respond to changes brought on by increased temperatures, longer heat waves, and reduced precipitation. All other alternatives would have this guidance incorporated in the revised forest plan.

## **All Alternatives**

Cumulative effects from all forest management actions would have similar environmental consequences to all alternatives. Impacts from population growth, land development, and increased water use on private lands would have the greatest impacts to aquatic ecosystems on the forest.

Management actions in the Upper Verde, Lower Verde, Agua Fria River, and Hassayampa sub-basins would have the greatest benefits to aquatic ecosystem and species populations.

Management direction provided in all alternatives would maintain or improve aquatic ecosystems on the forest. Implementation of native fish restoration projects on the forest would have the greatest benefit to expanding populations and distribution species viability on the forest.

## **Unavoidable Adverse Impacts**

The land management plan provides a programmatic framework that guides site specific actions but does not authorize, fund, or carry out any project or activity. Before any ground-disturbing actions take place, they must be authorized in a subsequent environmental analysis. Therefore none of the alternatives cause unavoidable adverse impacts. Mechanisms are in place to monitor and use adaptive management principles in order to help alleviate unanticipated impacts that need to be addressed singularly or cumulatively.

## **Irreversible and Irretrievable Commitment of Resources**

The land management plan provides a programmatic framework that guides site-specific actions but does not authorize, fund, or carry out any project or activity. Because the land management plan does not authorize or mandate any ground-disturbing actions, no alternatives cause an irreversible or irretrievable commitment of resources.

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